Reducing Losses from Natural Hazards

The Idaho State Hazard Mitigation Plan

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Idaho State Bureau of Disaster Services
State of Idaho Military Division

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Chapter 1 - EXECUTIVE SUMMARY

Introduction

The Idaho State Natural Hazard Mitigation Plan (the Plan) has been prepared by the Idaho Bureau of Disaster Services (BDS) to reduce disaster assistance costs and preserve disaster assistance eligibility for the State and the local governments within its borders. The Plan is the first comprehensive, state-wide mitigation planning effort to be conducted in Idaho.

Specifically, the Plan:

- Establishes a Framework for State-wide Action.
- Develops Opportunities for Local Mitigation Planning.
- Facilitates Integration of Mitigation into Post-disaster Response and Recovery.

Natural Hazards

Based on probability of occurrence and potential to result in significant damage and loss of life, natural hazards expected to occur in Idaho may be categorized as Principal or Other:

Principal

Flooding
Urban/Wildland Interface Fires
Earthquakes
Landsliding

Other

Avalanches
Drought
Lightning
Severe Storms
Volcanic Eruptions
Wind/Tornadoes

Flooding has produced the worst disasters in Idaho; significant events occurred throughout the 1900s. It occurs throughout the state and is seen on an almost annual basis. Three types of flooding are experienced in Idaho: riverine flooding, flash flooding, ice/debris jam flooding. Riverine flooding is generally associated with winter storms and spring runoff and produces the largest scale events. Flash flooding is associated with extreme precipitation and runoff events, insufficient infrastructure, and dam failures. Although typically limited in extent, flash floods are considered the most dangerous to human lives. Ice jam floods are associated with extreme winter cold events; debris jams may result from landsliding or human activities.

Urban/wildland interface fires are fires that occur in the zone transitioning from urban to wildland environments. Typically a “wildfire” in character, structures and infrastructure are generally also involved. Fires have resulted in significant disasters throughout Idaho’s history; the Summer 2000 fires were some of the most damaging on record. A combination of inappropriate forest management over the last century and continued development in the urban/wildland interface makes disastrous events increasingly likely.

Although rarely in the news, earthquakes are a fact of life in Idaho. Idaho experienced two of the largest earthquakes in the contiguous United States in the second half of the twentieth century. All of Idaho's counties have moderate or higher seismic hazard risk. A significant event in a heavily developed area could lead to major damage and loss of life.

Landslides are typically limited in extent but may result in significant damage and may persist over a long time. Of particular danger are “flows,” very wet slides that can strike like flash floods and do great damage with heavy debris loads. Landslides occur throughout the state but are most common in mountainous areas during extreme weather events.

Avalanches can only occur where snow can collect on steep slopes – in Idaho, they are found in the mountainous portions of the state. Avalanches occur rapidly, can be difficult to predict with certainty, and are sometimes initiated by their victims. The majority of ava-

lanches involving people occurs in the back-country, away from development, and involves a single party of recreational users.

Despite its long agricultural history, Idaho is correctly classified as an arid area with long droughts. Droughts in Idaho are generally associated with a sustained period of low winter snowfall. Droughts can have the broadest effect of all of Idaho's hazards, sometimes affecting all regions of the state simultaneously. Although deaths and injuries are rarely a direct outcome, wide-spread events can have significant impacts on the economic, environmental, and social well-being of the state.

While Idaho experiences thousands of strikes annually, lighting poses a minimal hazard to most individuals. Communication, utilities, and most critical facilities with electronic equipment employ techniques to minimize the impact on their operation.

Two types of severe storms are of concern in Idaho: winter storms with accumulations of snow and ice, extreme cold, and reduced visibility, and thunderstorms with hail, lightning, and high winds. Winter storms resulted in several disasters in the 1990s. Past disasters have been focused in the western and northern portions of the state, but severe winter storms are possible throughout Idaho. Thunderstorms occur in various locations throughout the state every year. Significant events are most common in summer; none have been significant to result in a disaster.

Volcanic eruption is generally not a major concern in Idaho due to the relatively low probability (compared with other hazards) of events in any given year. The potential for severe damages resulting from a major event is real, however. The geologic history of Idaho and the region has a significant component of volcanic activity.

Two types of significant wind hazards are possible in Idaho, straight-line winds and tornadoes. Both are generally associated with severe thunderstorms. Straight-line winds are responsible for most thunderstorm wind damage, with wind speeds in excess of 100 miles per hour on occasion. Tornado damage is generally confined to a narrow path but the tornado may travel over, and devastate, a large distance. Tornadoes are uncommon in Idaho but they do occur, averaging two to three events per year. Wind events do produce damage but have not resulted in any disasters in Idaho.

Natural Disasters

Disasters occur when natural hazard events cause significant damage to people, property, and/or the environment and can exact a high cost on Idaho's residents and economy. The most frequently occurring major disasters in Idaho reflect its geography and industries: wildland fires, floods (and associated landslides and debris flows), and droughts. Industries that depend on the natural environment for their livelihood (such as agriculture and timber) have been particularly hard hit in the past. A rapidly expanding population and an extension of urbanizing areas into the previously "wild" portions of the state is expected to increase the number and cost of disasters.

Two major concerns in Idaho are repetitive losses and damages associated with undeclared disasters. "Repetitive losses" refers to the significant amount of damage during a disaster that is experienced by residences and businesses that have been impacted in previous events. Such losses are often seen in flood disasters. Elimination of a relatively small number of problems could have a significant impact on overall, long-term damage costs. "Undeclared disasters" are those events that do not qualify for Federal and/or State disaster relief assistance. These events, while relatively minor in the larger picture, can still significantly impact citizens and businesses. Those impacted may suffer more than those involved in major disasters, as they receive no outside assistance.

Natural Hazards Mitigation

Mitigation seeks to reduce the risk of natural hazard occurrences and either reduce the effects of disasters or avoid those disaster all together. Mitigation may address:

- The physical system and the likelihood of a natural hazard event occurring.

- The community's vulnerability to the impacts of the event.
- The consequences to the community from the event.
- Any combination of these.

The primary purpose of hazard mitigation is to ensure that fewer communities are victims of natural disasters; in the face of the costs that result from disasters, though, mitigation can be seen as an investment in the future. Mitigation reduces demand for money and resources during response and in the aftermath. Current mitigation expenditures will also reduce the economic hardships which often accompanies the natural hazard event through the destruction of property, loss or interruption of jobs, and closing or disabling of businesses. Economic development is often dependent on a level of certainty in the ability to conduct business without loss or downtime; mitigation addresses that certainty while recovery does not.

Mitigation is especially important for the public sector, which suffers very high costs from disasters: infrastructure and facilities damage and secondary effects from these damages (e.g. contaminated water supplies). Few communities have the ability to make the large capital outlays necessary to replace their roads, treatment facilities, and other improvements in the short-term. Mitigation allows communities to invest over time rather than face huge one-time costs.

Although difficult to present in a spreadsheet, mitigation may be most important when reducing the costs associated with disasters that are non-financial and difficult to quantify in dollars, such as human suffering and loss of life. Individuals and communities are given a greater level of comfort by lowering the initial risk rather than picking up the pieces during the response and recovery phases. Consequently, the community's quality of life is improved and the region is a more attractive destination and home.

The Idaho Disaster Preparedness Act of 1975 as amended (Idaho State Code Chapter 10, Title 46) is the key controlling state legislation for disaster planning in Idaho, establishing the foundation for disaster damage reduction. Also, The Governor's Executive Order, 2000-04, establishes mitigation as a State priority, assigns mitigation duties to various State agencies, and directs coordination responsibilities. Finally, The Governor's Executive Order 2000-10, May 3, 2000, establishes mitigation responsibilities for flood disasters. The Bureau of Disaster Services (BDS) in the Military Division serves as the lead coordinating agency for preparedness, response, recovery, and mitigation efforts throughout the state.

The Robert T. Stafford Emergency Assistance and Disaster Relief Act (Stafford Act, P.L. 100-707) as amended is the key legislation driving Federal efforts at natural hazard mitigation.

Mitigation planning and activities conducted by local communities are generally directed by Mitigation Planning Committees (when they have been formed) or Local Emergency Planning Committees (LEPC). The majority of local planning work has been conducted under the Flood Mitigation Assistance program. Extensive mitigation work at the local level has been conducted with Hazard Mitigation Grant Program funding.

The State of Idaho's natural hazard mitigation goals are to:

- Save lives and reduce public exposure to risk.
- Reduce or prevent damage to public and private property.
- Reduce adverse environmental or natural resource impacts.
- Reduce the financial impact on the public.

Mitigation objectives are the fundamental strategies that the Plan prescribes to achieve the mitigation goals. They are specific statements of how the goals will be realized through action at State and other levels. The State of Idaho's natural hazard mitigation objectives are to:

- Enhance coordination of Federal, State, and local agencies and consistency of hazard impact reduction policy.
- Increase knowledge of hazards, hazard mitigation approaches, and the effects of

land uses, hazard impact reduction, post-disaster recovery, and resource management practices on natural and man-made environments and the risk and potential impact of the hazards.

- Reduce vulnerability to hazards and environmental impacts through coordination with growth management planning efforts, improved design and construction standards, and programs that address current at-risk development.
- Strengthen hazard preparedness, response, and education.

Mitigation Strategies

The Plan lists and describes Recommended State-wide Hazard Mitigation Actions that are the mechanisms for implementation of the above goals and objectives in the context of a given hazard. Through these actions the Plan coordinates State agencies and resources to be dedicated toward disaster impact reduction. A number of mitigation actions apply to many, or all, hazards and subsequently present a comprehensive approach to disaster impact reduction.

Actions may be implemented through the normal operations of an agency, through special funding or program, or integrated into disaster response and recovery. High-priority actions are identified and targeted for expedited implementation. Local governments are encouraged to undertake implementation when appropriate

For organization and planning, the recommended mitigation actions are categorized into five functional groups:

- Hazard Management
- Information/Education
- Infrastructure
- Regulatory
- Mapping & Analysis

Hazard Management actions directly reduce the community risk from a natural hazard event by reducing or eliminating the intensity or extent of the event. These include structural actions that physically alter the physical system and may also include acquisition actions that result in the direct control of elements of the physical system through purchase or condemnation.

Information/Education actions inform the community at large, interested professionals, and elected officials about the risk and steps that can be taken to reduce it. These actions may be seen as a long-term investment in mitigation and may be integrated into other actions.

Infrastructure actions directly reduce the community risk from a natural hazard event by developing new or modifying existing elements of the public infrastructure. These include structural actions that physically alter large and small elements of the community.

Regulatory actions are legal controls, administrative systems, and other public sector functions established or revised to guide private and public actions. This includes actions that affect a change in an individual organization or group of organizations to allow them to conduct their operations more effectively. It also includes actions that encourage private and public actions that will reduce community risk. Such actions may seek to reduce the existing risk or control possible future increases in risk.

Mapping & Analysis actions develop a greater understanding of the nature, extent, and probable impact of the hazard. Such an understanding is the foundation for other, more “proactive” actions.

Chapter 2 - INTRODUCTION

Chapter 3 - THE PLANNING PROCESS

Authority

State

The Idaho State Natural Hazard Mitigation Plan (the Plan) has been prepared by the Idaho Bureau of Disaster Services (BDS) in accordance with Idaho State Code Title 46, Chapter 10, *State Disaster Preparedness Act*, and the Governor's Executive Order, 2000-04, April 20, 2000. Under the executive order, BDS is specifically required to develop and coordinate the preparation and implementation of plans and programs for emergency mitigation, ensure that those plans and programs are consistent with national plans and programs, and ensure that state agency plans are consistent with state goals and procedures.[1]

The Plan reflects the role of BDS as a coordinating agency for disaster services by identifying current conditions and potential strategies but not mandating any actions outside of BDS' normal functions.

Federal

The Plan has also been prepared to meet the requirements of Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended by Public Law 100-707, Public Law 103-181(the Hazard Mitigation and Relocation Assistance Act of 1993), and Public Law 106-390, (the Disaster Mitigation Act of 2000). This section provides for increased Federal funding for hazard mitigation measures that follow disaster events, if an approved state hazard mitigation plan is in place. As regulations promulgating Section 322 are pending at the time of this writing, the Plan has been prepared to meet the guidelines specified for the former Section 409 of the Stafford Act. Section 409 was the previous state hazard mitigation plan directive, replaced in October 2000, by Section 322.

Other

The Plan has been prepared in concordance with the National Fire Protection Association's Standard on Disaster/Emergency Management and Business Continuity Programs, NFPA 1600 (2000 Edition). This standard was developed through a consensus process involving experts in the field and in cooperation with Federal Emergency Management Agency, the National Emergency Management Association, and the International Association of Emergency Managers. NFPA 1600 directs that disaster management plans should include opportunities and priorities for mitigation and that the "mitigation plan shall establish interim and long-term actions to eliminate hazards or to reduce the impact of those hazards that can not be eliminated."[2]

[1] Idaho Governor's Executive Order 2000-04, 2000.

[2] National Fire Protection Association, 2000; 3-6.2.3.

Uses of the Plan

In past disasters, BDS and Interagency Hazard Mitigation Teams (composed of State, Federal, and local agency representatives) have identified important recovery and damage reduction issues and developed recommendations. The lack of a cohesive process for implementing these recommendations, however, has left many of these issues unresolved and disaster damages uncurtailed.

The Plan addresses this inaction by making resolution of these damage reduction issues a State priority. By developing and following the Plan, Idaho will reduce disaster assistance costs and preserve disaster assistance eligibility for itself and the local governments within its borders. Like its predecessors, the Plan assesses hazard vulnerability and risk, identifies available program resources, raises critical issues that must be resolved, and provides recommendations. It goes beyond the earlier attempts by specifically presenting a framework for State action, laying the groundwork for local mitigation planning efforts, and providing guidance and resources for State and local mitigation actions during disaster response and recovery.

The Plan itself should be viewed as an organic entity that will require evaluation and revision as recommendations are implemented and new hazard concerns are identified. The Plan therefore may be viewed as an ongoing mitigation program rather than merely a document.

Framework for State Action

The Plan was developed to articulate both a state perspective and specific priorities for action. The State of Idaho intends to develop risk reduction strategies that lower the loss of life injuries, property damage, economic loss, and destruction of natural resources. The Plan addresses this intent through an approach to hazard mitigation that places a premium on three factors:

- *Coordination between State and Local Agencies*: The Plan serves as a framework for interagency and State and local coordination in risk reduction activities. Probable lead agencies are identified for each recommendation but in many cases the mitigation action is dependent on the efforts of many individuals and agencies. Coordination allows for overall efficiency by relying on each agency's strengths and reducing redundancy between agencies.
- *Cost-effective Implementation*: The Plan identifies those mitigation actions which offer the best potential for effecting real change in a given funding environment. It also signals to the various state agencies how they can most effectively contribute to mitigation activities in a coordinated manner.
- *Self-help Implementation*: The Plan will be implemented through State and local actions. Implementation will occur at the lowest level that is appropriate for each recommended action. This will, to the fullest extent possible, involve the community that benefits from the mitigation and give them the maximally appropriate control over the action. Funding for implementation of the recommendations will vary depending on the action.

A clear statement of the State's approach to hazard mitigation allows for continuance of the intent of the Plan beyond the recommendations listed here. As additional hazard concerns and mitigation technique are identified in the future, the Plan can be amended to better meet the stated goals and objectives.

By identifying priorities for action, the Plan provides direction for the utilization of funding from State and Federal assistance programs. In particular, along with local needs and interagency coordination, the Plan will guide the administration of Hazard Mitigation Grant Program funds.[3] Current Federal regu-

[3] Per Section 404 of the Stafford Act, P.L. 100-707.

lations require that projects funded through the Hazard Mitigation Grant Program be consistent with the State Hazard Mitigation Plan.[4] The precise method of selecting products for funding is specified in the State's Hazard Mitigation Grant Program Administrative Plan.

Finally, the Plan serves to establish the foundation for cooperation between the State and both Federal and local governmental entities by clearly presenting the State's perspective and priorities in hazard mitigation. By proactively asserting its position, the State increases its bargaining power in negotiations.

Local Mitigation Planning

The recommendations in the Plan are, in general, appropriate in scope to state-wide action. They are therefore broad, encompassing a range of possible conditions and situations. While these are appropriate for policy-level and general actions, "on-the-ground" mitigation efforts that address specific, local hazards require a more in-depth analysis of local conditions. In some cases, this additional level of planning will be conducted by State agencies, with the expertise and resources appropriate to the task, following up on the broad recommendations in the Plan. In other cases, the next step in mitigation planning is most appropriately conducted by local governments.

The Plan places an emphasis on local planning and implementation as an important element of the overall mitigation effort. Local governments may choose to follow-up on the broad recommendations of the Plan, develop their own mitigation actions based on local assessment and available resources, or a combination of the two. Local involvement brings three key benefits to the table:

- *Community Values and Priorities*: Local involvement ensures that mitigation actions reflect the needs and priorities of the local community. What one community views as an acceptable up-front cost (either monetary or socially) for long-term disaster damage reduction may be unacceptable to another. Mitigation (as with all planning and governmental action) is most effective when the community understands and supports the effort.
- *Local History and Knowledge*: A community brings a unique perspective to hazard mitigation, having in many cases lived with and witnessed the hazard firsthand. When coupled with professional expertise relevant to the hazard, this sense of history and personal knowledge can be a powerful tool for effective planning.
- *Local Scale*: Mitigation actions do not need to be grand in scale to achieve good returns. Small actions, appropriate to a community's resources, can be effective steps towards the mitigation effort, especially where community involvement leads to a greater understanding of the hazard and a personal investment in the effort.

The Plan establishes the groundwork for local mitigation planning efforts by:

- Providing guidance on preparing a local plan and a list of resources for further information and assistance;
- Describing potential mitigation actions for the assessed hazards (Appendix A); and,
- Indicating State priorities.

Post-disaster Response & Recovery

The Plan is a powerful tool for the integration of mitigation into post-disaster response and recovery efforts at all levels: local, State, and Federal. Response and recovery operations generally occur under extreme time and resource pressures and offer limited opportunities for careful analysis and planning. By listing appropriate and critical mitigation actions, the Plan gives mitigation greater standing and potential for inclusion in the response and recovery operations.

Appendix B lists potential mitigation actions that should be considered by any State or other agency undertaking post-disaster mitigation efforts.

[4] Per 44 CFR 206.435(a).

Development of the Plan

The history and current status of the Plan's development are presented in Appendix C.

DOCUMENT OVERVIEW

The Plan is a comprehensive review of natural hazards, disasters, and mitigation (past, present, and future) in Idaho. Consequently, it is a weighty, and possibly intimidating, document. Despite this bulk, it is written for those new to natural hazards and mitigation, as well as experienced emergency management personnel. This section provides a basic orientation to the four chapters that comprise the body of the Plan.

Natural Hazards, Mitigation, & Planning sets the groundwork for subsequent discussions of natural hazards, disasters, and mitigation. The chapter presents background information, providing a common language and understanding of the concepts that are fundamental to the Plan. An overview of the history and impacts of natural hazards and disasters in Idaho provides a context for the Plan. Current natural hazards- and mitigation-related policies and programs are broadly discussed. Readers new to natural hazards and mitigation work should spend sufficient time to become fully comfortable with the material; more experienced readers may choose to focus on the Idaho-specific information.

Within this chapter, the *Opportunities for Local Mitigation Planning* section orients the reader towards the role that local mitigation planning can play in the implementation of the goals and objectives of the Plan. Local government representatives, in particular, are directed towards this section as tool to use while reviewing the document.

Hazard Assessment & Mitigation Strategies details the potential for, and likely impacts of, natural hazard events and disasters in Idaho and outlines steps that may be taken to minimize those impacts. A state-wide overview reviews the geophysical and socio-economic characteristics of Idaho, discusses broad mitigation strategies, and presents a list of recommended mitigation actions that are applicable to multiple hazards. A detailed hazard assessment (the probability and potential impacts of hazard events and disasters), discussion of existing mitigation policies and programs relevant to the hazard, outline of mitigation strategies, and a list of action recommendations are presented for each hazard.

Recommended Mitigation Actions presents the details for each recommended mitigation action listed in the preceding chapter. The specifics of the proposed actions, essential background information, suggested responsibilities for implementation, and current status is described for each recommendation. The actions are presented in five categories: *Hazard Management*, *Information/Education*, *Infrastructure*, *Regulatory*, and *Mapping & Analysis*.

Implementation wraps up the mitigation process by presenting guidelines for how the recommendations will be put into action, how the progress of meeting the Plan's goals and objectives will be monitored, and how the Plan will be updated as needed. Of particular importance is the section *Prioritization* that includes a list of the highest priority recommended actions.

Chapter 4 - NATURAL HAZARDS, MITIGATION, & PLANNING

NATURAL HAZARDS AND DISASTERS IN IDAHO

Overview

Introduction

The Plan addresses *natural* hazards and the disasters that result from them. Idahoans are exposed to hazards from a number of other sources as well—hazardous materials, transportation accidents, civil unrest. The Plan's exclusion of these man-caused hazards does not mean that they are insignificant. We need to begin somewhere, and since natural disasters are perceived to be most dangerous or have the greatest potential for catastrophic consequences, we begin there.

Definitions

This section establishes a shared language for the discussion of natural hazards and disasters and documents their impact in Idaho and the world.

Natural Hazard Terms

Natural Hazard

A *hazard* is defined by the National Emergency Management Association (the national association of state emergency management directors) as, "Any situation that has the potential for causing damage to life, property, and/or the environment."[5] When referring to *natural hazards* (as the Plan does), this definition can be refined to:

Any geologic, climatic, hydrologic, or other geophysical element or condition that has a potential for causing damage to life, property, and/or the environment.

The scope of this planning effort is limited to "unusual" or acute phenomenon rather than ongoing natural hazards which do not lead to disasters. For example, a swiftly flowing river through a town poses an obvious potential for damage to life (through a drowning danger). Such a hazard though is addressed through other means (e.g. the town's Emergency Medical Services capabilities). This plan is only concerned with that stream when it overflows its banks and has the potential for significant damage that may in turn lead to an emergency or disaster. A natural hazard event may range from minor (limited or only superficial damage to life, property, and/or the environment) or catastrophic (significant and widespread damage to life, property, and/or the environment).

Vulnerability

The *vulnerability* of a community to a natural hazard event may be defined as:

[5] NEMA Glossary (n.d.).

The extent of the community (life, property, and environment) that is placed in jeopardy by the natural hazard.

The smaller the vulnerability, the greater a community's ability to withstand and respond effectively to an event.

Risk

Similarly, *risk* is an overall description of the danger posed by the natural hazard. Simply put, risk is the measure of both the likelihood of an event and the community's vulnerability to the natural hazard, or:

The probability that the community will suffer significant damage to life, property, or environment due to the natural hazard.

By looking at risk, the decision maker can determine not only which events are the most *probable* but also which will have the greatest *consequences*. *Risk management* is the balancing act that minimizes the long-term damage to a community.

Emergency Management Terms

Preparedness

The *Preparedness* phase sets the groundwork for disaster response and recovery. It includes all:

Actions taken prior to an event to enable effective response and recovery actions.

Investments of time and resources in the preparedness phase may more than pay for themselves during and after an event in improved response and recovery.

Mitigation

Natural hazard *mitigation* is generally defined as:

Sustained action taken to reduce or eliminate the long-term risk to people and property from hazards and their effects.

Mitigation is distinguished from other major emergency management functions such as response, recovery, and preparedness by its sustained and long-term approach to reducing and eliminating risk by addressing either the probability of the event or the vulnerability of the community. The key here is that mitigation actually lowers the long-term risk (makes the community "disaster resistant") rather than merely improving a community's ability to address or bounce back from that risk. An action must also be cost-effective to be thought of as mitigation; i.e., it should be less expensive, in terms of life and property, than the emergency response and recovery actions that it eliminates.

Response

The *Response* phase of emergency management is what many people think of when they picture natural hazard events. This is the phase when there are:

Immediate actions taken to protect life, property, and the environment against the impacts of the event.

The particular response will depend on the nature and severity of the event but may include emergency medical, search and rescue, evacuation and emergency housing, and hazard control (e.g. fire fighting and flood control) efforts.

Recovery

The *Recovery* phase of emergency management is less glamorous than response but may be more critical. In this phase there are:

Actions taken to restore losses to life, property, and the environment suffered by individuals and the community.

Recovery may be a prolonged phase, over the course of years in some cases, and is generally more costly than response. Even a large city community may be overwhelmed by the cost of replacing major public infrastructure such as roads, water treatment plants, power utilities, or elements of the economic base.

Natural Hazards

Introduction

Natural hazards occur throughout the world. Their distribution is controlled by geophysical factors such as geology, climate, hydrography, and land cover. Table 1 lists common natural hazards which do or can occur in the United States.

Many natural hazards pose significant risk throughout the country (e.g. floods, wildland fires, and severe storms) while others have limited event likelihood or vulnerability in large portions of the country (e.g. tsunamis and avalanche). Public perception is not always a good indicator of risk. Earthquakes are an excellent example of a natural hazard that is a high risk to communities throughout the nation despite the perception that these events are limited to a specific area.

Table 1 - Common Natural Hazards	
Avalanche	Landslide
Coastal Flood	Lightning
Drought	Meteorite Impact
Dust Storm	Riverine Flood
Earthquake	Severe Storm
Extreme Cold	Tsunami
Extreme Heat	Wildland Fire
Flash Flood	Volcanic Eruption
Hurricane	Wind/Tornado

Natural Hazards in Idaho

Because of the great diversity of landscape and climate, Idahoans must coexist with a number of natural hazards (Table 2). Located in the Intermountain West, however, Idaho is spared the natural hazards associated with coastal and lowland areas (i.e. hurricanes, coastal flooding, and tsunamis). The state's moderate climate (due to the influence of the Pacific Ocean) also limits its exposure to extreme heat and cold events and dust storms.

The frequencies listed in Table 2 may give a misleading perception of the relative significance of each natural hazard to the state. A number of the more frequently occurring natural hazards (e.g. flash flooding and high wind) are generally limited to minor events while some of the less frequent have the potential for producing catastrophic events. The relative significance of the natural hazards is discussed in detail in the following chapter (*Hazard Assessment & Mitigation Strategies*). Distribution of each natural hazard is also discussed in detail in that chapter.

Table 2 - Idaho Hazards Ranked by Historical Frequency	
Hazard	**Frequency of Damaging Events**
Landslide/Debris Flow	Almost every year
Flash Flood	Every 1-2 years
Wind/Tornado	Every 1-2 years
Flood	Every 1-5 years
Severe Storm	Every 1-5 years
Avalanche	Every 2-5 years
Lightning	Every 2-5 years
Wildland Fire	Every 3-5 years
Earthquake	Every 15 years
Drought	Every 15 years
Volcanic Eruption/Ashfall	Infrequent

Natural Disasters

Introduction

Discussions of "natural disasters" can be confusing as the term can be either a general description of an event or a legal determination of need for assistance. It is important to distinguish between the two meanings as there are important qualities and constraints associated with the latter. The Plan will distinguish between the two with capitalization ("disaster" for the event, "Disaster" for the legal determination).

Natural Disaster Events

A *natural disaster* is a severe natural hazard event, one that has a substantial impact on the community generally requiring outside assistance. Based on the Idaho State Code's definition of "disaster,"[6] a *natural disaster* may be defined concisely as:

An occurrence or imminent threat of widespread or severe damage, injury, or loss of life or property resulting from any natural hazard.

The level of impact necessary to qualify an event as a disaster may vary by the extent of a community's resources. For example, a flooding event which results in the displacement of ten households will be a greater challenge for a small town than for a large urban area. For the town, but not the city, this event might be a disaster.

Natural Disaster Declarations[7]

Local governments in Idaho have the ability to declare a "Local Disaster" within their political subdivision, activating local and intergovernmental disaster emergency resources. This declaration is generally reserved for events that are beyond the normal response capabilities of local agencies.

Following a Local Disaster declaration, local officials may request State assistance. If the event is recognized by the State government as being beyond the response and recovery capabilities of the local community (that is, a disaster has occurred or that the occurrence or the threat of a disaster is imminent), the Governor will declare a State "Disaster." The declaration activates the disaster response and recovery aspects of state and intergovernmental disaster emergency plans relevant to the situation (e.g., deployment of the National Guard and use or distribution of supplies and facilities).

If the Governor determines that the extent and/or severity of the Disaster is greater than the State's ability to respond and recover, a request for a Federal assistance is made. When the President of the United States subsequently determines that assistance by Federal agencies is warranted, the President makes a Federal declaration of Disaster.

The State and Federal governments may share costs of disaster expenses for declared Disasters. As mentioned previously, recovery places the most severe financial strain on a local or state government. There are two major categories of Federal Disaster assistance available during the immediate recovery phase:

- Individual Assistance - for damage to residences and businesses or personal property losses.
- Public Assistance - for repair of infrastructure, public facilities and debris removal.

It should be noted that Federal assistance supplements but does not replace State and local contributions; the State must also commit significant State funds and resources. Federal declaration also makes Federal funding specifically targeted at mitigation available.

[6] Idaho State Code 46-1002(3)
[7] Material in this section from Idaho State Code Title 46, Chapter 10, *State Disaster Preparedness Act*.

Natural Disasters in Idaho

Overview

As noted above, Idaho in the home of a wide variety of natural hazards and potential events. Table 3 summarizes some of the major disasters that occurred in the state during the 20th century. Wildland fires are prominent on the list and remind the observer that Idaho remains a predominantly undeveloped state. Floods (and associated landslides and debris flows) are also significant forces in the state, and with wildland fires demonstrate the danger that can exist at the interface of wildland and urban areas. Major losses to drought and insect infestation illustrate that the agricultural industries are also at risk of economic damage (and not just the more urban activities of the state). Finally, the Borah Peak earthquake and the Teton Dam failure demonstrate that some events, while infrequent, offer the potential for great damage and loss of life.

Appendix D lists declarations by the Governor for Disaster assistance from 1976-2000. Declarations by cities and counties that did not result in State assistance are not included.

Table 3 - Major Historical Disasters in Idaho

Year	Event
1910	Devastating wildland fires consume 1/6 of northern Idaho's forests and destroy many communities.
1959	August and September flash floods and mud slides in Boise (“Cloudburst Floods”).
1960	July and August wildland fires in Hells Canyon and Idaho City areas.
1976	Teton Dam collapses in southeastern Idaho, killing 11 and forcing 300,000 people to flee their homes.
1977	Severe drought leads to Disaster declaration for many Idaho counties.
1983	Borah Peak earthquake
1984	Ice jam flooding on the Lemhi River at Salmon.
1985	Grasshopper infestation leads to pesticide spraying on over six million acres of range.
1989	The worst wildland fires season since 1910; thousands of acres in south central Idaho burn and the town of Lowman is partially destroyed.
1992	The worst wildland fire season in Idaho's recorded history.
1994	Summer wildland fires burn approximately 750,000 acres.
1996	Flooding throughout Northern Idaho.
1996/97	Heavy snow, landslides, and floods from winter storms.
1997	Spring flooding in Southeastern and Northern counties.
2000	1,599 wildland fires throughout state burn 1.36 million acres.

Source: Idaho State Bureau of Disaster Services, n.d.

Table 4 lists a breakdown of Disaster types for State and Federally declared Disasters during the period 1976 to 2000. Floods were the predominant hazard with wildland fires and landslides also significant. The significant difference in the number of State and Federal declaration for some hazards (such as landslides and wildland fires) reflect the generally limited spatial extent of these hazards.

Figure 1 illustrates the distribution of these Disasters throughout the state. Ten regional declarations (one for "Northern Idaho" and nine for "State") are not mapped. Only two counties were not specifically named in State declarations, Franklin and Teton. Bonner County had eight specific State declarations during the period; Washington County had seven; Boundary, Kootenai, Nez Perce, each had six; and, Boise and Elmore each had five.

One Federal Disaster was declared for the entire state. Four counties experienced four Federal Disasters, five experienced three, and twelve experienced none. In general, the Panhandle region experienced the highest rate of declared Disasters, reflecting the extensive flooding during the period.

Disaster Costs

In comparison with many other states, Idaho has relatively few declared Disasters. (During the period of 1990-1999, 460 Federal disasters were declared, three of which were in Idaho.) This is a result of both the natural hazard regime and the density and distribution of the population.

Table 4 - Declared Disasters 1976-2000

Disaster Type	State Declaration	Federal Declarations
Drought	3	1
Earthquake	1	1
Flood-related	28	5
Landslide	8	2
Tornado	1	0
Volcanic Eruption	1	1
Wildland Fire	12	1
Winter Storm	5	2
All Disasters*	54	9

*"All Disasters" does not equal the sum of the event types as several Disasters were declared for more than one event type.

Despite this relatively low frequency, disasters still exact a high cost on Idaho's residents and economy. According to the National Center for Atmospheric Research, flood-related disasters alone cost an average of $35,500,000 (in 1999 dollars) for the period 1995-1999. Costs associated with selected State and Federally declared disasters are listed in Appendix E. Industries that depend on the natural environment for their livelihood (such as agriculture and timber) have been particularly hard hit in the past.

With a rapidly expanding population and an extension of urbanizing areas into the previously "wild" portions of the state, the number of disasters is expected to increase. An increase in the cost of disasters can be expected to correspond to the increase in the number of disasters.

A growing concern in emergency management is the large costs associated with repetitive losses. A significant percentage of households suffering losses have experience repetitive events, especially from flooding. Elimination of a relatively small number of claimants could have a significant impact on overall, long-term damage costs.

Undeclared Disasters

Idaho's limited number of large population centers and vast undeveloped areas allow many natural hazard events to occur without impact to life or property. Even when humans and their property are impacted, rural areas with low population densities may not achieve a "critical mass" of damages (by dollar amount) necessary to capture the attention of State or Federal government and trigger a Disaster declaration. Events with limited spatial distribution such as landslides, avalanches, and flash floods rarely receive Federal declarations; floods frequently do.

While these smaller disasters may not have large total damages, the individuals affected may be as heavily impacted as those who experience "major disasters." This is particularly true for prolonged or repeated events that occur at "below threshold" levels for years, never triggering a declaration but resulting in extensive cumulative damage. Recurrent landslides and prolonged droughts often fall into this category and residents and communities find themselves left to deal with the situation with limited resources.

These undeclared disasters have an overall significant impact on the state and its residents. They are, though, frequently overlooked in the discussion of disaster management and mitigation. Three examples follow.

Sandpoint Flash Flood/Debris Flow. Warm rain on snow led to a significant flash flood event near Sandpoint in May, 1991. The torrents blew out large sections of the road leading to Schweitzer Basin ski area, stranding dozens of people, contaminated the city's primary water supply, and heavily damaged the water treatment facility. The cost to clean out and repair the water treatment facility ran to several hundred thousand dollars. The local government was significantly challenged by the recovery costs associated with restoring basic services.

Lewiston "Elk's Club" Landslide. Landsliding that begun on May 4, 1998, blocked Snake River Avenue in Lewiston, restricting access to some businesses. A second slide on May 13, destroyed a mobile home and caused an additional road closure. The Lewiston Elks Temple was also threatened by ongoing slide activity in the vicinity. Total public costs for this event are estimated at just under $4.5 million; approximately four million dollars for Idaho Transportation Department and $485,000 for Nez Perce County.

Bonners Ferry Landslide. A landslide January 30, 2000, blocked the only access road to the community of Ravens Point (near Bayview), Kootenai and Bonner Counties. A second rockslide two days later exacerbated the problem. Access to a total of 75 homes was cut off. Kootenai and Bonner counties, Timber Lakes Fire District, and Lakes Highway District provided essential services. Residents shared personal resources and maintained communication through a specially designed web page. A 65-passenger ferry was leased for travel to and from Bayview. Governor Kempthorne and the Legislature authorized up to $725,400 for BDS to reimburse local agencies. The Natural Resources Conservation Service provided much needed Federal assistance in stabilizing the banks above the lake and removing road blockage. The State paid the non-Federal match required by NRCS. The request for presidential disaster declaration was disapproved.

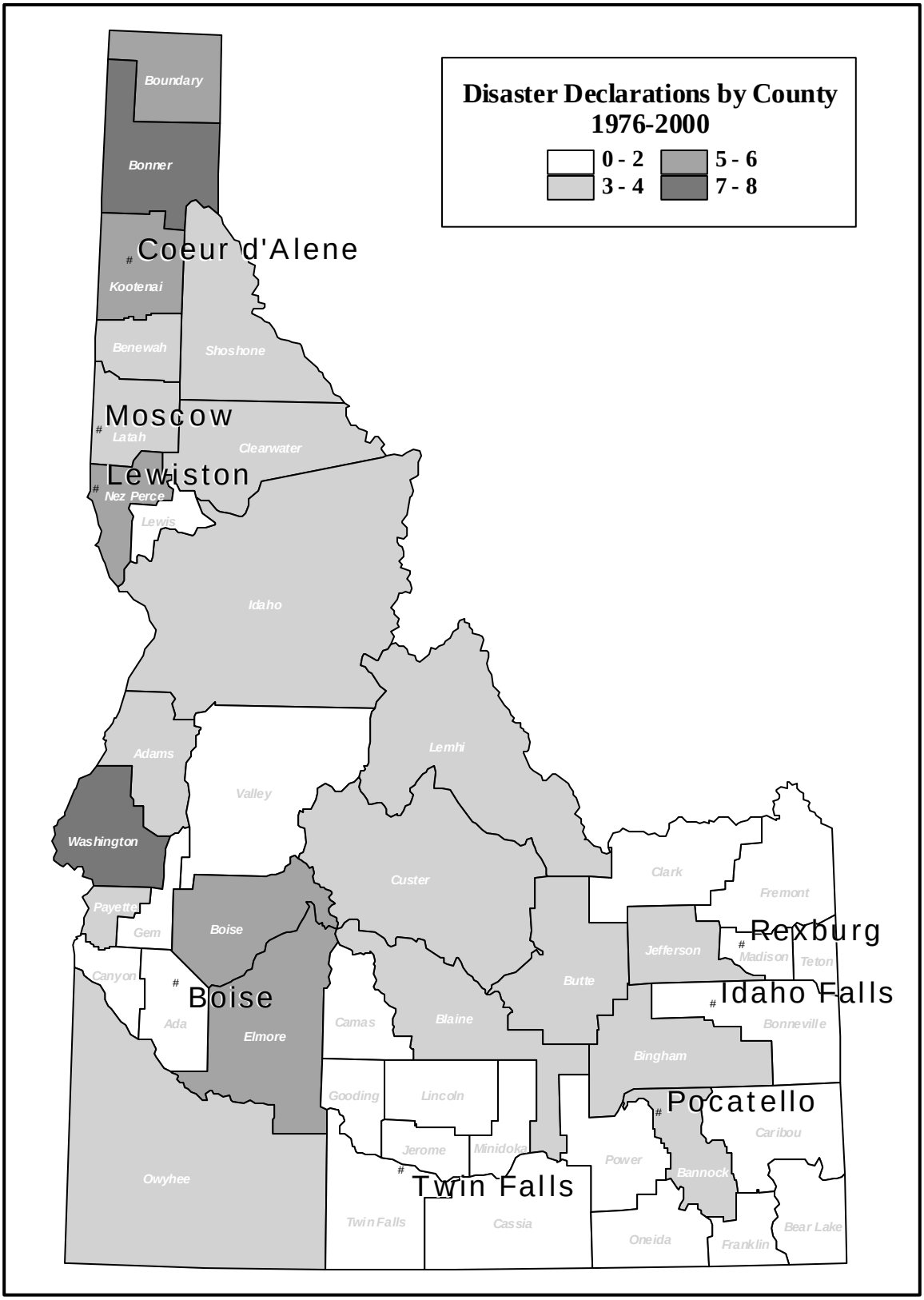


Figure 1 - Disaster Declarations by County, 1976-2000

NATURAL HAZARDS MITIGATION

Introduction to Mitigation

By reducing or eliminating the risk from natural hazards we minimize the impacts of natural disasters. This section defines and discusses the role and benefits of mitigation in disaster management.

The Role of Mitigation

Mitigation may occur either prior to or following an event. The intent of mitigation is to focus on actions that produce repetitive benefits over time. Measures may include steps to strengthen a home, so that a family and belongings are better protected from floods, earthquakes, and tornadoes. These measures may help business and industry avoid damages to their facilities and remain operational after a damaging event. Mitigation measures may also include strengthening hospitals, fire stations, and other critical service facilities so that they can remain operational or reopen more quickly after an event.

As discussed previously, the risk that a natural hazard event will be severe enough to become a disaster is a consequence of the likelihood of an event occurring and the vulnerability of the community. Event occurrence is in turn a function of the physical system, e.g., the hydrology and climatic factors that drive river flows. Similarly, the community's vulnerability is a function of its location relative to the event and the ability of its population and property to withstand the forces of the event. When the event does occur and the community is vulnerable, there will also be *consequences* (i.e. impacts on the community), which may be physical, financial, and/or social.

Mitigation seeks to reduce this risk and either reduce the effects of disasters or avoid those disaster all together. Therefore, mitigation may address:

- The physical system and the likelihood of a natural hazard event occurring.
- The community's vulnerability to the impacts of the event.
- The consequences to the community from the event.
- Any combination of these.

For example, flood mitigation measures might include:

- Levee construction to constrain river flows (modify the physical system).
- Elevation of homes in the floodplain so that floodwaters do no damage (modify the community vulnerability and consequences).
- Purchase of flood insurance (modify the consequences).
- Designation of floodplains as non-built open space, a step that increases river flow storage and keeps vulnerable structures out of harm's way (modify the physical system, community vulnerability, and consequences).

Mitigation seeks to make the built environment less vulnerable in two key ways:

- Avoiding hazard areas, by directing development or relocating existing development to safe locations away from hazard areas.
- Fortifying the built environment, by designing or strengthening buildings and infrastructure to withstand hazards.

Benefits from Mitigation

The primary purpose of hazard mitigation is to ensure that fewer communities are victims of natural disasters; in the face of such costs though, mitigation can be seen as an investment in the future. Mitigation reduces demand for money and resources during response and in the aftermath. Current mitigation expenditures will also reduce the economic hardships which often accompanies the natural hazard event through the destruction of property, loss or interruption of jobs, and closing or disabling of businesses. Economic development is often dependent on a level of certainty in the ability to conduct business without loss or downtime; mitigation addresses that certainty while recovery does not.

Mitigation is especially important for the public sector, which suffers very high costs from disasters: infrastructure and facilities damage and secondary effects from these damages (e.g. contaminated water supplies). Few communities have the ability to make the large capital outlays necessary to replace their roads, treatment facilities, and other improvements in the short-term. Mitigation allows communities to invest over time rather than face huge one-time costs.

Although difficult to present in a spreadsheet, mitigation may be most important when reducing the costs associated with disasters that are non-financial and difficult to quantify in dollars, such as human suffering and loss of life. Individuals and communities are given a greater level of comfort by lowering the initial risk rather than picking up the pieces during the response and recovery phases. Consequently, the community's quality of life is improved and the region is a more attractive destination and home.

A far-sighted or proactive approach to mitigation gives the best return on a community's investment. Mitigation is typically less expensive to implement when included in the planning and construction stage rather than after a building has been constructed. To take such an approach, a community needs to understand the risks that it faces, prioritize these in the face of community values, and prepare a plan to mitigate the risks within the context of available resources.

Hazard Mitigation and Mitigation Planning in Idaho

State Legislation

The Idaho Disaster Preparedness Act of 1975 as amended (Idaho State Code Chapter 10, Title 46) is the key controlling state legislation for disaster planning in Idaho, establishing the foundation for disaster damage reduction. The Governor's Executive Order, 2000-04, establishes mitigation as a State priority, assigns mitigation duties to various State agencies, and directs coordination responsibilities. The Executive Order also states Idaho's general philosophy regarding disaster management:

WHEREAS, the role of state government should be to support and enhance local community emergency response efforts, including focusing state agency activities on supporting regional and community needs throughout Idaho.[8]

The Governor's Executive Order 2000-10, May 3, 2000, establishes mitigation responsibilities for flood disasters. All state agencies with grant or loan programs involving construction are directed to evaluate flood hazard and preclude inappropriate development. Additionally, all state agencies responsible for programs which affect land use planning, including state permit programs, are directed to take flood hazards into account when evaluating plans and encourage land use appropriate to the degree of hazard involved. Finally, all state agencies responsible for the disposal of lands or properties shall evaluate flood hazard

[8] Governor's Executive Order, 2000-04.

and notify the receiver of the land or property of the risk.

Federal Legislation

The Robert T. Stafford Emergency Assistance and Disaster Relief Act (Stafford Act, P.L. 100-707) as amended is the key legislation driving Federal efforts at natural hazard mitigation. The Stafford Act was most recently amended in October, 2000, by the Disaster Mitigation Act (DMA) of 2000. These amendments significantly altered some key components of the Stafford Act and as regulations enacting these changes are pending at the time of the Plan, the full effect of these changes remains to be seen.

State Agencies

Overview

The Bureau of Disaster Services (BDS) in the Military Division serves as the lead coordinating agency for mitigation efforts throughout the state. Actual "on-the-ground" natural hazard mitigation operations are conducted by a number of other agencies: Department of Agriculture, Department of Commerce, Department of Education, The Office of the State Board of Education, Department of Labor and Industrial Services, Department of Lands, Department of Water Resources, and Idaho Geological Survey.

Bureau of Disaster Services

The Bureau of Disaster Services (BDS) in the Military Division is the lead coordinating agency for natural hazard and disaster preparedness, response, recovery, and mitigation in the state. BDS' specific mandated mitigation duties are:

Develop and coordinate the preparation and implementation of plans and programs for mitigation to prevent or reduce the harmful consequences of disasters in accordance with section 46-1006(1), Idaho State Code. [9]

BDS has three mitigation-related goals:

- Adoption of all-hazard mitigation plans by all Counties by 2010.
- Establishment of a state-wide advisory board on hazard mitigation.
- Development and ongoing funding for a hazard mitigation grant fund for assisting cities and counties in meeting their non-Federal share of project grants.

BDS oversees several ongoing hazard mitigation programs. Additionally, BDS has served as the lead for the Interagency Hazard Mitigation Team post-disaster mitigation planning processes. BDS does not have directive authority and is only a coordinating agency; therefore its ability to pursue "on-the-ground" natural hazard mitigation work is limited.

Other Agencies

In addition to coordinating with BDS and providing personnel and assistance as requested, a number of State agencies are required to perform natural hazard mitigation activities relevant to their jurisdictions.[10] These include:

- Department of Administration: Promote and develop mitigation strategies to prevent or reduce damage as a result of disasters for state owned or leased buildings and structures. Lead all agencies in construction of buildings and other infrastructure that precludes uneconomic, hazardous, or unnecessary use of floodplains in connection with such facilities.
- Department of Agriculture: Act as the primary support agency for mitigation activities as they pertain to agricultural issues.
- Department of Commerce: Act as the primary support agency for mitigation activities as they pertain to economic injury/losses as a result of disasters.

[9] Ibid.
[10] Ibid., and Idaho Governor's Executive Order, 2000-10.

- State Board of Education: Promote mitigation activities to reduce the risk from structural and nonstructural hazards in school facilities, colleges, universities and area vocational-technical facilities. Promote mitigation activities to reduce the potential loss of the state's historic and cultural resources as a result of natural hazards.
- Department of Lands: Develop and direct the state's mitigation activities for state endowment land.
- Department of Water Resources: Develop mitigation programs for flood and drought in concert with the Bureau of Disaster Services. Coordinate the evaluation of flood hazard potential. Also, encourage a broad and unified effort to prevent uneconomic use and development of the state's floodplains and, in particular, to lessen the risk of flood losses in connection with state lands and installation and state-financed or supported improvement
- Idaho Geologic Survey: Formulate and direct the State's geologic hazard reduction effort by providing hazard identification, analysis, and mapping of the geologic threats; and provide a geologic representative(s) for hazard mitigation teams which involve geologic hazards.

Federal Agencies

Federal agencies provide mitigation assistance in Idaho through direct action (particularly post-disaster) and funding of state and local mitigation projects. The agency in the Federal government tasked with responding to, planning for, recovering from and mitigating against disaster is the Federal Emergency Management Agency (FEMA). FEMA has increased its emphasis on mitigation during the last decade due to what it calls the unacceptable loss of life and property from recent disasters, and the prospect of even greater catastrophic loss in the future. The National Mitigation Strategy has two goals:

- To substantially increase the public awareness of natural hazard risk so that the public demands safer communities in which to live and work; and
- To significantly reduce the risk of loss of life, injury, economic costs, and destruction of natural and cultural resources that result from natural hazards.

FEMA's Mitigation Action Plan, developed from the National Mitigation Strategy, directs State and local governments to develop sustained administrative structures and resources for mitigation programs, adopt and enforce building codes and land use measures, and conduct ongoing public information campaigns on natural hazard awareness and mitigation. FEMA administers a number of programs that have been or may be active in Idaho.

Other Federal agencies with mitigation responsibilities include the United States Army Corps of Engineers, USDA Forest Service, Natural Resource Conservation Service, Bureau of Reclamation, and the United States Fish and Wildlife Service.

Mitigation Programs

The Plan is the first comprehensive, state-wide mitigation planning effort to be conducted in Idaho. Previous mitigation planning has been restricted to disaster response-related plans and hazard specific plans. The principal mitigation efforts have been conducted through the programs described below.

Emergency Management Performance Grant Program

The State funds local mitigation and preparedness projects under the Emergency Management Performance Grant program (EMPG). Participating communities develop performance goals for their emergency management programs and design projects to meet those goals. After being funded, the participants must evaluate progress and report back to BDS to remain eligible.

Federal Disaster Assistance

Funding provided through Federally-declared Disaster assistance programs may be used for mitigation actions as part of the recovery process. This funding is administered by BDS. Examples of such applications include:

- Individual Assistance:
  Floodproofing techniques
  Elevating utilities
  Elevating appliances and space heaters
- Public Assistance:
  Relocation of facilities
  Best engineering practices
  Upgrading to code
  Slope stabilization
  Upgrading bridges and culverts
  Floodproofing buildings
  Floodproofing utilities

Flood Mitigation Assistance Program

The Flood Mitigation Assistance program was created with the goal of reducing or eliminating claims under the National Flood Insurance Program. Funding is made available annually and may be used only for flood mitigation planning and implementation. Communities first prepare a mitigation plan which, when in place and approved, makes them eligible for implementation project grants. The Federal share of the funding is 75 percent and up to one-half of the local cost-share can be in-kind contributions. The program is administered by BDS. Eligible implementation projects include:

- Elevation of insured structures.
- Acquisition of insured structures and real property.
- Relocation or demolition of insured structures.
- Dry flood proofing of insured structures.
- Minor, localized structural projects that are not fundable by State or other Federal programs.

The applicant community must be a participant in the National Flood Insurance Program and implement the 1994 or later Uniform Building Code. A list of Counties and their plan completion status is included in Appendix F.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) provides funding for mitigation in areas that receive assistance through Federally-declared Disasters. HMGP is administered by BDS. The funding is intended to enable mitigation measures to be implemented during immediate recovery from a disaster and to implement the State or local hazard mitigation plan. Funding is limited and competitive and proposals must demonstrate that the projects are cost-effective and will substantially reduce future damages. HMGP funding may equal up to 15% of the total Federal disaster funding. Local governments, Tribes, special districts (e.g., school, fire, and drainage) and certain nonprofit organizations (e.g., hospitals and emergency response) are eligible to apply for HMGP funds. When individuals are affected (projects such as elevating homes), the local government must be the sponsor. Communities seeking grants must participate in the National Flood Insurance Program, enforce the 1991 or later edition of the Uniform Building Code, regulate development in hazardous areas, and have a hazard mitigation plan.

Typical HMGP projects include:

- Elevation of homes above the floodplain.
- Debris basins, retention ponds.
- Streambank stabilization.
- Pumps, floodgates, floodwalls.
- Strengthening old masonry buildings against earthquakes.
- Securing light fixtures and HVAC in schools.
- Acquisition and relocation.

A complete list of current Hazard Mitigation Grant Program projects and their status at the time of the Plan may be found in Appendix G.

National Dam Safety Program

The National Dam Safety Program (NDSP) is administered in Idaho by IDWR. This program focuses on inspection, classification, and emergency planning for dam safety. Funding may be used for a variety of projects including: dam safety-related training for state personnel and training in the field for dam owners to conduct annual maintenance reviews; revision of state maintenance and operation guidelines; improvements to dam inventory databases; and, creation of dam safety videos and outreach materials.

National Earthquake Technical Assistance Program

The National Earthquake Technical Assistance Program (NETAP) is a technical assistance program created to provide short-term, no-cost architectural and engineering support related to earthquake mitigation. Examples of NETAP projects are seismic retrofit/evaluation training, evaluation of seismic hazards critical/essential facilities, post earthquake evaluations of buildings and development of retrofit guidance for homeowners. BDS administers this program in Idaho.

National Flood Insurance Program and Related Programs

The National Flood Insurance Program (NFIP) enables property owners in participating communities to purchase Federally underwritten flood insurance. Communities participate in the NFIP by adopting and enforcing a floodplain development controls designed to reduce future flood risks in the 100-year floodplain. The program is available to all flood-prone communities (participation in NFIP is voluntary) and most eligible communities have elected to participate. The program is administered in Idaho by IDWR and insurance is sold through state-licensed companies.[11] Under the Community Rating System program (CRS), communities that apply more stringent protection standards than those required by the NFIP and/or comprehensive floodplain planning are eligible for reduced insurance rates for property owners.

Project Impact

Project Impact is a Federal initiative (administered through FEMA) to promote hazard mitigation through the development of "disaster resistant communities." The program is directed towards the implementation of mitigation measures that are cost-effective and designed to reduce injuries, loss of life, and damage and destruction of property, including damage to critical services and facilities under the jurisdiction of the States or local governments. FEMA has indicated though that the program is intended to address the six listed natural hazards: earthquakes, tsunamis, tornadoes, hurricanes, flooding, and wildland fires. Additionally, FEMA has stated that program funding and assistance will be intended primarily to support:

- Community hazards identification and risk assessment activities.
- Community hazard mitigation planning and community actions, such as public-private partnerships intended to guide and facilitate the planning process.
- Partnerships that will result in the necessary level of public awareness and public support for mitigation actions.

Four Idaho communities have received or are currently receiving funding under Project Impact:

- City of Boise (1998)
- City of Kamiah (1999)
- Blaine County (2000)
- Clearwater County (2001)

Local Mitigation Efforts

Mitigation planning and activities conducted by local communities are generally directed by Mitigation Planning Committees (when they have been formed) or Local Emergency Plan-

[11] Idaho Governor's Executive Order, 2000-10.

ning Committees (LEPC) The LEPC are mandated by hazardous material requirements (CERA Title 1) requirements but often fill the role of general emergency management committees.

Local mitigation planning status is summarized in a table in Appendix F.

Appendix H contains the Shoshone County Mitigation Plan as an example of local efforts.

Idaho Success Stories

The benefits of mitigation actions may be difficult to appreciate until an event of disastrous severity occurs. The two case studies below illustrate some the benefits that the state may expect from undertaking a comprehensive mitigation program.

Case Study 1 – Idaho Falls

Ongoing street flooding issues in the Crow Creek drainage area of Idaho Falls were addressed through the construction of an innovative detention pond/pumping system adjacent to Idaho Falls High School. The practice field between the high school and Ravsten Stadium was lowered six feet and covered with sod, creating a high-volume (5 million gallons) detention pond. The pond is able to temporarily hold runoff piped to it from nearby storm sewers during periods of heavy rain. Following detention, a pumping station at the south end of the field takes the water to a 36-inch stormwater pipe that carries the runoff out of the area. By holding the runoff in the new detention pond, the system distributes the runoff volume over a longer period, avoiding the flooding that resulted when the 36-inch pipe was overloaded during past events.

The $1.3 million project was funded in part by a $258,000 grant through the Hazard Mitigation Grant Program. An August 1999 storm provided a first test of the system; it performed successfully.

Case Study 2 – Paradise Creek

In 1998, Palouse-Clearwater Environmental Institute and the University of Idaho completed a joint project to address stormwater runoff issues and enhance wildlife and water quality values along Paradise Creek. Small "pocket wetlands" were created and planted with hydrophytes (wetland plants) that will naturally clean stormwater runoff from a nearby parking lot. Meanders were constructed in the deeply incised straight channel to slow the flow in the stream. Streambanks were relocated and slopes adjacent to the channel were re-contoured, creating a wider floodplain that will provide additional water storage area during heavy precipitation and runoff events. Streambanks were stabilized using bioengineering techniques and trees and shrubs were planted along Paradise Creek to provide wildlife habitat, enhance aesthetics, and to improve the water quality of the stream. This work was funded in part by a $50,360 grant from the Hazard Mitigation Grant Program.

OPPORTUNITIES FOR LOCAL MITIGATION PLANNING

As described above, the vast majority of local mitigation planning work in Idaho has been conducted through FMA flood mitigation plans. The Plan in general and this section in particular seek to expand the opportunities for mitigation planning to include all hazards. This section reviews the benefits to local government and communities of mitigation planning, presents a brief overview of what a local mitigation plan would involve, and provides a few words on the implementation of the plan.

Appendix I presents a detailed process description for local planning efforts. Appendix J contains a list of resources (informational

and funding) that may be useful to mitigation planning efforts. Appendix A contains several examples of possible local mitigation actions adapted from the state-wide actions recommended by this plan. Local governments preparing planning efforts are urged to review these Appendices and contact BDS for additional assistance.

The Benefits of Local Mitigation Planning

As Idaho shifts from it frontier origins to an increasingly urban state, residents' expectations of their local governments rise. Where once a sense of "self-reliance" prevailed, now residents look to their local governments to provide police and other emergency services and ensure that their homes and public facilities are not built in hazardous areas. Additionally, state law requires planning and preparedness for emergencies and disasters.[12]

Mitigation planning is an important element of community responsibility for protection of life and property. Growing liability issues suggest that this is a wise and easily defensible action for governments to take. Even if project funds are not immediately available, the fact that hazards have been identified, risks evaluated, and strategies developed to reduce their impact shows that governments are taking steps to protect their citizens.

Just as importantly, mitigation planning is a key to securing funding for projects. As part of the movement by the Federal government to reduce disaster costs, criteria for Federal response assistance are being increased, and assistance is now contingent on the existence of mitigation plans. Pre-disaster mitigation grants also require a commitment to mitigation practices as evidenced in participation in the National Flood Insurance Program, implementation of modern building codes, and regulation of development in hazardous areas, and promulgating loss reduction plans.

Other opportunities presented by the planning process include:

Public Education – A well conducted planning process will by its nature inform the community residents about the hazards and disasters that may affect them and the steps being taken to mitigate the risks.

Risk Assessment – Decision makers (in both government and business) will be better prepared to fulfill their roles when empowered with a thorough local risk assessment.

Economic Development - A proactive stance on disaster management issues may also offer improved economic development opportunities by creating a greater sense of "certainty" that the community will be there, and functioning, in the future.

Basis for Recovery after a Disaster – The mitigation plan lies the groundwork for post-disaster recovery to be accomplished in forward thinking mode. Rather than merely restoring the community to a "pre-disaster" condition, the community can take advantage of funding and technical assistance to improve the situation and build a more disaster-resistant community.

[12] Idaho State Code 46-1009.

The Local Mitigation Plan

Hazard mitigation plans mirror the communities that develop them. They can range from simple documents of ten or so pages to long documents with fold-out maps and colored pictures. There is no cookie-cutter approach. There are, however, specific things that a plan needs to address. There are also specific approaches that are required—mitigation planning does not exist in a vacuum. It requires public buy-in in the strategies, which means public participation in the development of those strategies. This participation needs to be documented in the plan. The plan also needs to be officially recognized—and promoted.

Although it is a government document, the flood mitigation plan must reflect a strong element of public input in the development of strategies and identification of appropriate project types. To this end it is essential that a committee be constituted and empowered. It should contain members representing:

- Emergency management
- Planning and zoning
- Building services
- Public works
- A response agency (law enforcement, fire, medical)
- Business
- Banking, insurance
- Construction (contractor, developer)
- Residents
- Civic groups
- Special interest groups

In some jurisdictions, it may be useful to have the mitigation planning committee as a subcommittee of the Local Emergency Planning Committee (LEPC). And even though there may be public representatives on the committee, public input is essential in the form of public meetings for review and comment.

While its format is at the county's discretion, the plan itself should contain at least the following:

1. **The nature of hazards in the county and the frequency of occurrence.** The county emergency manager may have already completed a hazard analysis.
2. **The effects of hazard events on population, property, infrastructure, and resources.** Describe damage from previous events including costs for losses and response activities. This requires research. Newspapers, library, historical societies are resources for more distant events. Insurance companies and city and county governments are a resource for more recent information including costs.
3. **Hazards with the greatest impact.** Hazards have different impacts and consequences. Select those that whose probability is not insignificant and whose occurrence would have a significant affect on the county. The county emergency manager should have materials and procedures to assist in this process.
4. **Maps of areas affected by the hazards.** Flood Insurance Rate Maps provide information about flooding hazards, but maps with actual flood levels or indications of damage are even better. USGS topological maps may be appropriate for other hazards such as fault, landslide, and wildland fire hazards.
5. **Acceptable level of risk**. This is the baseline amount of damage, property loss, or economic impact that the county is willing to accept as a cost of "living with" the hazards. There is always a level of tolerance: consider damage to paved roads—some potholes are accepted, but there is a certain threshold—whether it be the cost of sending a crew out, perceived danger to

the public, or public outcry—which will trigger repair.

6. **Long-range goals to prevent or reduce the harmful consequences of the hazards**. This should include county goals as well as goals arising from public input. This information may exist in the county's comprehensive plan, floodplain management or planning and zoning ordinances. Public meetings are appropriate forums for obtaining additional input for goal-setting.

7. **Laws and ordinances that can empower mitigation actions**. BDS area field officers can provide information about some state and Federal laws. Other state agencies (Department of Water Resources, for instances) and Federal agencies (Forest Service or Environmental Protection Agency, for instance) can provide additional information about applicable laws and regulations. City and county officials, of course, are the best source for local laws that may be applicable.

8. **Background issues that affect consensus.** Any number of issues may affect the way people interact and make decisions—minorities, special populations, political or philosophical points of view, economic situations, seasonal conditions all may affect consensus-building.

9. **Strategies to achieve mitigation goals**. While government agencies may have relevant—and useful—ideas, it is essential that public review and comment be solicited at this point. Public acceptance is critical to both planning and implementation. Citizens' viewpoints often give perspective to the viewpoints of government officials.

10. **Potential projects based on the strategies-and approximate costs**. Once again, public input can provide a forum for useful solutions that may cut across agency boundaries and require resolution of turf battles—all of which are important to the resolution of problems produced by natural hazards.

11. **Possible funding sources and cost-share resources.** Look for local and private as well as Federal and state. The Bureau of Disaster Services has some small grants available for pre-disaster mitigation, and large grants when a Federal disaster is declared. The Army Corps of Engineers, Natural Resources Conservation Service, and Economic Development Agency also have a number of pre- and post-disaster assistance programs. The mitigation plan does not have to exhaustively report on these programs, but it should indicate them as resources. Note also that nearly all involve a local cost-share. These are common resources for all counties. The plan should identify local resources as well—available through businesses, for instance.

12. **A schedule for review and update.** Based on new hazards, changed risks, or updated demographic information, changes may be necessary. It may be an effective approach for some counties to work on one or two hazards initially and to address other hazards in subsequent years. Obviously, once the priority hazards have been addressed, most updates will focus on changes resulting from growth in population and industry.

13. **The planning process used and summary of the involvement of citizens and local government officials**. Although the process may be obvious to the county and the committee, since the plan can serve as the basis for funding, it is important that the planning approach and results be set down so that outside parties can have confidence in the broad-base consensus in the plan's strategies and projects.

14. **Official promulgation by the local governmental entity.** As on official document, the mitigation plan not only supports project funding, it serves as a resource document for planning and zoning, development, and hazard management.

Communities are urged to look towards the State Plan during the development of their local plans. At the simplest level, consistent

terminology will facilitate cooperative arrangement and work together. Some communities may wish to view the State Plan as a guide or template in laying out their own document; other may merely reference it on occasion. All are reminded that it does reflect the State's perspective on and priorities for hazard mitigation and local plans that develop a consistent direction will be most able to take advantage of State program and funding. In the following hazard assessment and mitigation strategy sections, potential local actions are presented. Communities are encouraged to incorporate these into their planning efforts where they are consistent with local goals and priorities.

Implementing the Local Mitigation Plan

The plan should be distributed to all committee participants, to the heads of county departments, to civic leaders, and any individual or organization identified in the planning process as an opinion-maker or as having a stake in mitigation. A cover letter from the board of county commissioners should explain the reason for the plan and the reason that recipients should be interested in it—public safety, reduced costs of disasters, community cohesiveness.

At the government level, it should inform policy-based decisions on safety issues, buildings, land-use, and planned development. It will have implications for funding loss-reduction projects as well as recovery programs after a damaging event occurs.

For businesses, homeowners, and opinion leaders, the plan provides awareness of hazards and their consequences and a rationale for community-based decision-making, as well demonstrating that individuals need not be helpless victims of natural events.

As with the State Plan, ongoing evaluation and revision are necessary to keep the plan functioning over the long-term. Recommendations can be carried out, as funding is available (either through post-disaster assistance or, preferably, through pre-disaster grants or local funds). A plan "champion," either officially charged or unofficially assumed, will go along way towards identifying opportunities for implementation and keeping the plan alive as an active element of the community.

Chapter 5 - HAZARD ASSESSMENT & MITIGATION STRATEGIES

OVERVIEW

Hazard Assessment

Idaho's geophysical and socioeconomic characteristics control which natural hazards will occur and what their impact will be in the state. The sections that follow include a brief overview of these characteristics to provide a background for the detailed discussions in the individual hazard sections.

Geophysical Characteristics of Idaho

Idaho is a big and diverse state. The entire state covers 83,564 square miles with a land area of 82,412 square miles and 1,152 square miles of water. Its northeastern boundary is Montana, with Wyoming on the east, Utah and Nevada on the south, Oregon and Washington on the west, and British Columbia, Canada on the north. It has forests, deserts, mountains, narrow valleys, and plains. Altitudes range from the shores of the Snake River in Lewiston at 738 feet above sea level to the summit of Borah Peak's at 12,662 feet. Steep mountain streams and large, forceful rivers are found throughout. With a 600-mile north-south profile, it has a vast exposure to the dominant westerly flow of weather, and its climatic characteristics vary not only from north to south, but from east to west. The geology, hydrography, climate, and land cover all play a role in the natural hazard environment that characterizes our state.

Geology and Terrain

Idaho features a diverse and dramatic geologic setting. Throughout much of the state, outcroppings, steep slopes, and high relief make the residents very aware of the foundation of the state. This immediacy also makes for a geologically active state with earth movement through earthquakes and landslides, large and small, still shaping the terrain.

Northern and central Idaho is mountainous, with peaks reaching elevations over 12,000 feet. The continental divide runs along the lower portion of the border with Montana. The landscape is characterized by large changes in elevation in short distances (over 4,000 feet in some cases), steep slopes and narrow V-shaped valleys. Past glaciation is evident is some areas. The northern portion of the state is underlain with ancient (1.4 billion years old) metamorphic rocks with pronounced layering. Major mountain ranges include the Selkirk, Coeur d'Alene, and Cabinet Mountains. Central Idaho is underlain by the Idaho Batholith, a 70- to 100-million years old and deeply eroded complex of coarse-grained granitic rocks. This area is marked by massive mountain ranges such as the

Sawtooth, Salmon River, and Bitterroots. The deeply eroded canyon of the westward-flowing reach of the Salmon River bisects this area. In both regions, the exposed rocks present an unstable terrain subject to slides and rockfalls and the landscape has been and is being formed by these factors. Soils formed from the granitic rocks of Central Idaho are given to instability after vegetation disturbance from wildland fire or logging.

The southern portion of the state, in contrast, is characterized by the broad basalt plains that are deeply cut by river valleys. This rock is part of one of the largest basaltic lava flows in North America and is quite young (geologically speaking). Although now dormant, there is a possibility of renewed lava flows in the future. Where exposed as tablelands and steep cliffs, this rock is also unstable and given to slides and rock falls.

The subsurface geology of Idaho creates the potential for seismic activity throughout the state. Only the northern most portion of the state (the Panhandle) and a belt running from the southwest to Rexburg in the east (corresponding somewhat to the Snake River Plain) are considered relatively "inactive." The key phrase is "relatively," though; it is important to note that the entire state is considered to have at least a moderate seismic threat and earthquakes can occur anywhere.

Climate

Idaho, although also diverse in climate, is generally characterized by warm dry summers and cold moist winters. Flanked by the Cascade Range on the west and the Rocky Mountains on the east, the state is shielded from the significant precipitation found on the Pacific coast and the severe artic cold spells and destructive summer storms found on the Great Plains. In general, violent or prolonged adverse weather events (e.g. tornadoes and extended winter storms) are rare.

The state's annual average precipitation is 22 inches but there is significant variation. The considerable north-south extent of the state (seven degrees of latitude) and lifting of air masses over the mountainous areas results in heavy precipitation in the north and in the central Idaho mountains (up to 60 inches, much as snow) and low precipitation in the downwind, "rain shadow" southern and eastern areas (down to 10 inches). Winter snowfall ranges from a low of 20 inches in the southwestern valleys and canyons to a record of 300 inches (and perhaps up to 400 inches) in the high mountains.

November, December, and January are generally the wettest months of the year in most Idaho locations. In the central and northern half of the state a second cycle of precipitation usually occurs during spring. Spring and summer thunderstorm activity provide much of the moisture for the eastern communities located in the rain-shadow of the central mountain mass.

Idaho's significant north-south extent and altitudinal variations also influence temperatures, with the highest summer temperatures occurring in the south. Further from the moderating influences of the Pacific Ocean and generally higher in elevation, the southeastern corner of the state is cooler than the southwestern corner. Representative locations are described in Table 5.

Water Bodies and Streams

Idaho's water bodies and streams play a key role in its natural hazard climate. Large rivers are found throughout the state and, due to the rugged terrain, they often share their floodplains with development. Most Idaho residents live near rivers that are subject to periodic flooding.

Much of Idaho's precipitation falls as snow, leading to a stream flow pattern keyed to spring and early summer snow melt. In general, stream flows are highest during this period and lowest in fall and winter. Extensive water storage facilities (over 12 million acre-feet of storage) in the state modify this pattern though, especially downstream on the larger rivers. These facilities and off stream use of the water can significantly alter the natural flow patterns.

The Snake River, cutting across the width of the southern portion of the state, is a key feature in the Idaho – its basin covers 88% of the state. The river is impounded at Palisades Reservoir upon entering the state from Wyoming and then flows from the reservoir out onto the Snake River Plain.

Table 5 - Representative Climate Examples

City	Elevation (feet above sea level)	Annual Mean Precipitation (in)	Mean Snowfall (in)	July Average High Temperature (°F)	January Average Low Temp (°F)	July Average Afternoon Humidity
Boise	2,840	12.0	21.3	90.5	21.2	22%
Coeur d'Alene	2,160	25.7	52.2	85.1	22.3	34%
Idaho Falls	4,730	10.9	37.5	86.0	10.0	25%
Lewiston	1,440	12.4	19.8	89.0	27.1	34%
Pocatello	4,450	12.2	47.2	88.0	14.4	38%
Twin Falls	3,960	10.5	31.3	85.0	19.0	27%

Source: Idaho Department of Commerce, n.d. (a).

The river curves across southern Idaho through the state's largest valley where river may be completely depleted by irrigation diversions during the summer. Continuing west, the flow is replenished by the Snake Plain aquifer (groundwater comprises up to one half of the flow at Glenn's Ferry).

It then turns north to form the western boundary and travels through Hell's Canyon (the deepest canyon in North America) before turning west into Washington state at Lewiston. As it enters Hell's Canyon, the Snake has been altered by river regulation for hydropower production and inflow form the Boise and Payette rivers.

Major tributaries, such as the Salmon and the Clearwater, begin in the mountains of Central Idaho as small, steep streams and often maintain a relative steepness throughout their courses. Lakes include Dworshak Lake, a 53-mile long reservoir, and numerous alpine lakes in the high-mountains.

Two Panhandle rivers, Kootenai and Clark Fork, are regulated by dams upstream in Montana. Flood control and power production increase late summer through winter flows. The Clark Fork is also controlled by the Cabinet Gorge dam, whose power operations produce daily fluctuations (along with Noxon Rapids Dam in Montana).

The Spokane River flows west from Lake Coeur d'Alene, the state's largest lake, passing quickly out of the state at Post Falls. Two major tributaries, Coeur d'Alene and the St Joe, originate in Idaho's Bitterroot Range and flow into Lake Coeur d'Alene. Other large lakes located in the northern Panhandle include Pend Oreille and Priest. Along with Lake Coeur d'Alene, these lakes are regulated by dams at their outlets. In general, lake levels are lowered in the late fall to provide for winter flood protection. Smaller lakes include Hayden Lake, Spirit Lake, Upper and Lower Twin Lakes, and Hauser Lake.

Bear River enters the state near Bear Lake, having drained a 2500 square mile, somewhat mountainous basin. At that point, it is regulated by upstream storage and is depleted by irrigation diversions in Wyoming and Utah.

High flows are common in May and June and very low flows in July, August, and September. Through Idaho, it is effected by reservoir releases for power generation, unregulated tributary inflow, and irrigation diversions. Major tributaries, Thomas Fork and Malad River exhibit flows typical of unregulated streams. Peak runoff occurs during the snow melt season and then declines through the summer months.

Land Cover

The land cover in Idaho reflects the wide variations in elevation, climate, and population that exist in the state. The central, mountainous portion of the state is the least developed, given over to large tracts of forest and barren land. The agricultural and range lands ring this center with some concentration to the south and east. As reflected in Table 6, urban and other built areas cover very little of the state.

With a relatively small percentage of its land given over to urban uses, Idaho can be correctly seen as state where natural processes still predominate. The large extent of forest and range land also raises the possibility for large wildland fires.

Socio-Economic Characteristics of Idaho

Idaho is also diverse socially and economically. The 20th century saw major changes as the population grew dramatically, urban areas developed, and the number of industries expanded. Idaho has both modern, high-tech and traditional, close-to-the-land cultures. The amount and distribution of the residents, the work that they do, the public facilities and infrastructure that they use, and the ownership of the land all play a role in how natural hazards impact our state.

Population

The 2000 Census reported Idaho population as 1,293,953. This is a 28.5% increase from the 1990 census (1,006,734), making Idaho one of the fastest growing states in the nation The population is fairly concentrated in the metropolitan areas, defined as counties with at least one city with a population of greater than 20,000. According to a 1999 report, *Profile of Rural Idaho*, rural areas cover 88.3% of the state but have only 36.2% of the total population of the state. The "urban" areas, with 1998 population figures for the largest city, are: Ada County (Boise – 157,452), Bannock County (Pocatello – 53,074), Bonneville County (Idaho Falls – 48,122), Canyon County (Nampa – 41,951), Twin Falls County (Twin Falls – 33,296), Kootenai County (Coeur d'Alene – 32,565), Nez Perce County (Lewiston – 30,363), and Latah County (Moscow – 19,312). Three-fourths of the growth during the last decade occurred in urban areas, especially Ada, Canyon, and Kootenai Counties.

Table 6- Land Cover

Land Cover	Area (acres)	Portion of State
Range Land	21,985,700	41.1%
Forest Land	20,636,600	38.6%
Agricultural Land	7,788,500	14.5%
Barren Land	2,058,000	3.8%
Water	525,600	1.0%
Wetland	262,100	0.5%
Urban or Built-up Land	208,700	0.4%
Tundra	11,400	0.1 %
Total	53,476,600	100.0%

Source: Idaho Department of Commerce, n.d. (b).

The concentrated nature of the urban areas makes large populations susceptible to specific hazard events such as flooding and earthquakes, while dispersed populations in rural areas are more susceptible to loss of basic services during weather-related disasters.

Due to low population densities in rural areas, widespread hazards may affect a limited number of people. Assistance (or pre-disaster risk reduction) in these rural areas may receive a low priority when cost-benefit analyses determine government spending, even though risk of damage may be higher to these residents who are isolated from basic and emergency services.

A resident's choice of home location may reflect a lifestyle choice. A strong sense of self-reliance and resistance to outside interference may be found in much of the rural portion of the state. Many communities may express a preference to organize themselves and respond to emergencies without state or Federal assistance.

There has been some erosion of these traditional values in areas that have seen a recent influx of formerly urban residents. Such "ex-urban" residents may maintain a desire for urban levels of service (e.g., emergency response) in their new surroundings. This migration to the urban/rural interface is expected to continue and may pose great challenges for disaster response providers in the coming years who will be working with equipment and infrastructure that does not support the level of response expected.

Economic

Idaho's economy is a mixture of manufacturing (high-tech and traditional), service and trade, and resource extraction and processing. The total Gross State Product for 1997was $29,149,000,000; Table 7 gives a breakdown by sector.

All of these sectors are vulnerable to a variety of hazards. Disruptions could range from minor and temporary (e.g. brief power outages due to a severe storm) to serious and potentially permanent (e.g. loss of capital property and workforce due to a major earthquake). In the services sector, the role of tourism related services is growing in importance in both rural and urban areas. Disruptions of these services can have a dramatic effect on a local economy, especially where the economic activity is seasonally and coincides with the disruption. The agricultural sector, which often operates on a thin margin, is susceptible to damage by a range of hazards including severe storms and wildland fires. The southwestern portion of the state in particular has benefited economically from the high technology boom of the last several years. Given the number of inputs (e.g., personnel, facilities, power, and raw materials) and the precision required in this manufacturing activity, even an event not seen as severe (such as a moderate earthquake) could bring down this industry for a number of days and generate a substantial loss. Mining, along with some manufacturing and agricultural activities, may pose significant pollution hazards after hazard events that disrupt waste control systems.

Table 7- Economic Contribution by Sector

Economic Sector	Gross State Product (1997)
Manufacturing	$5,809,000,000
Services	$4,860,000,000
Trade	$4,799,000,000
Finance/Insurance/ Real Estate	$3,644,000,000
Transportation/ Communication/ Utilities	$2,492,000,000
Farm/Agricultural Services	$1,730,000,000
Construction	$1,669,000,000
Mining	$273,000,000
Government	$3,873,000

Source: Idaho Department of Commerce, n.d. (b).

It is likely that an overall economic shift away from extractive industries and towards high-tech, urban industries will continue. This shift has a potential to impact the risk of wildland-related hazards (e.g., wildland fires), the general distribution of the population, and the required distribution of response and recovery resources.

Infrastructure

Idaho depends upon road, rail, air, and water transportation. The northern Panhandle region is bisected by Interstate 90 (running east-west), while Interstate 84 crosses the southern plains and Interstate 15 runs north-south through the southeastern corner of the state. The major year-round north-south connector is US Highway 95, linking Boise in the south to Sand Point and the Canadian border in the north. Much of the state's surface transportation network runs through canyons, confined by steep slopes and rivers. Small natural hazard events (e.g., minor flooding or small landslides) can lead to serious disruptions, as has been the case several times in recent years. Water transportation is not considered at risk of natural hazard disruption within the state as barge traffic ends at Lewiston (although disasters in adjacent states that disrupt the barge system could have significant economic impacts on Idaho).

A 1988 study of approximately 670 elementary and secondary schools in Idaho, found that many could suffer major structural damage if earthquakes reached the intensity projected by the seismic hazard map of Idaho. They also found that some degree of damage would occur in 102 of 109 school districts that were considered and that 20% of the buildings are at very high risk and 45% are at high risk. Many communities look to the schools as gathering places and use them as shelters in emergency situations. The condition of many these buildings precludes such use.

Idaho is served by a variety of land-line telephone, cell telephone, radio, and television systems. Many rural communities, especially those in mountainous areas, have limited communication resources and may have a single communication line with the "outside world."

Key power utilities include natural gas and electricity. A large percentage of Idaho's electricity is produced from hydropower facilities; some of the power generated in Idaho is sold to out-of-state communities. Additional power generated from fossil fuels in other states is imported into Idaho. Two major natural gas pipelines cross Idaho: one runs across the southern end of the state, entering east of Pocatello, leaving west of Boise, and sending a spur out of the southeastern corner of the state; the second, cuts across the northern section from Canada and past Coeur d'Alene. A major petroleum products pipeline crosses the southwestern corner of the state and has major linkages to Mountain Home Air Force Base and Gowen Field in Boise. The interconnected nature of power utilities in the region makes discussion of hazard implications to the system difficult. Supplying companies primarily face transmission and distribution rather than generation issues. Service disruptions are a risk for all communities but are greatest for communities with limited resources (i.e. non-redundant systems).

Irrigation, industrial, and municipal water supply systems harness the rivers and large groundwater reserves, including one of the largest groundwater aquifers in the country, the Snake Plain aquifer. Natural hazards pose risks of service disruption and contamination of water supply, especially in areas with significant potential pollution sources (e.g., industrial facilities and mine waste). In some cases, the water supply system, in the form of irrigation channels, increases the potential for flooding damages by providing easy paths for flood waters into communities.

Idaho has hundreds of dams, ranging from large government reclamation and private utility hydroelectric facilities to small privately-owned dams for local flood control or irrigation purposes. Reservoir storage in Idaho totals over 12 million acre-feet. Between 1905 and 1930, many dams were built in the state to store water, primarily for irrigation. A second spurt of dam construction, primarily for power generation, between 1950 and 1969 significantly increased water storage capacity. Dworshak Reservoir, on the North Fork of the Clearwater River, is the largest reservoir in Idaho with a capacity of 3.4 million acre-feet. The reservoir is used for flood control, hydroelectric power generation, recreation, and navigation. A major concern is that the expected life of a dam is 75 years and many dams are either approaching or have exceeded

this age. Dams, through either overtopping or outright failure, may pose significant risks to downstream communities.

Land Ownership

Like much of the Intermountain West, a high percentage of Idaho is publicly held and managed land. The state's total land area is 82,751 square miles or approximately 52,960,640 acres (with water bodies, the total is 83,574 square miles or approximately 53,487,000 acres). Table 8 contains a breakdown of ownership for the state. Figure 2 illustrates distribution of land ownership throughout the state.

Table 8- Ownership of State Land Area

Land Owner/Manager	Portion of State
Federal	63%
Private	30%
State	5%
Tribal	1%
City/Other	< 1%

Source: Idaho GAP Analysis Project, 2000.

The large Federal land management presence requires a high degree of cooperation between land managers and local communities in emergency response and planning activities. Many remote communities feel a lack of control over their own destiny. Access issues may be a significant problem when communities or economic activities are isolated by Federal or State lands or the holdings of individuals and businesses.

Government Structure

Idaho counties are political subdivisions of the state and the primary units of local government. They serve as an administrative arm of state government, providing services required by the state such a slaw enforcement, welfare and maintenance. In recent years, counties have taken on functions of a quasi-municipal character, providing urban services such as planning and zoning, water supply and sewage disposal, those traditionally provided by incorporated cities. The counties have the primary response and recovery role in disaster management; the State provides assistance as requested and necessary.

State Inventory of Past Events

Table 2 (in the preceding chapter) lists the historic frequency of each hazard. These frequencies give some insight into the impact but may be misleading regarding the relative significance of each natural hazard to the state. A number of the more frequently occurring natural hazards (e.g. high wind) are generally limited to minor events while some of the less frequent have the potential for producing catastrophic events.

Table 4 (in the preceding chapter) lists the State and Federal Disaster Declarations within the state during the period 1976-2000. These were declarations all resulted from major events, resulting in significant impacts to lives and/or property.

A detailed discussion of significant past events follows in each of the individual hazard sections. Several events involved multiple hazards and are covered under each relevant hazard.

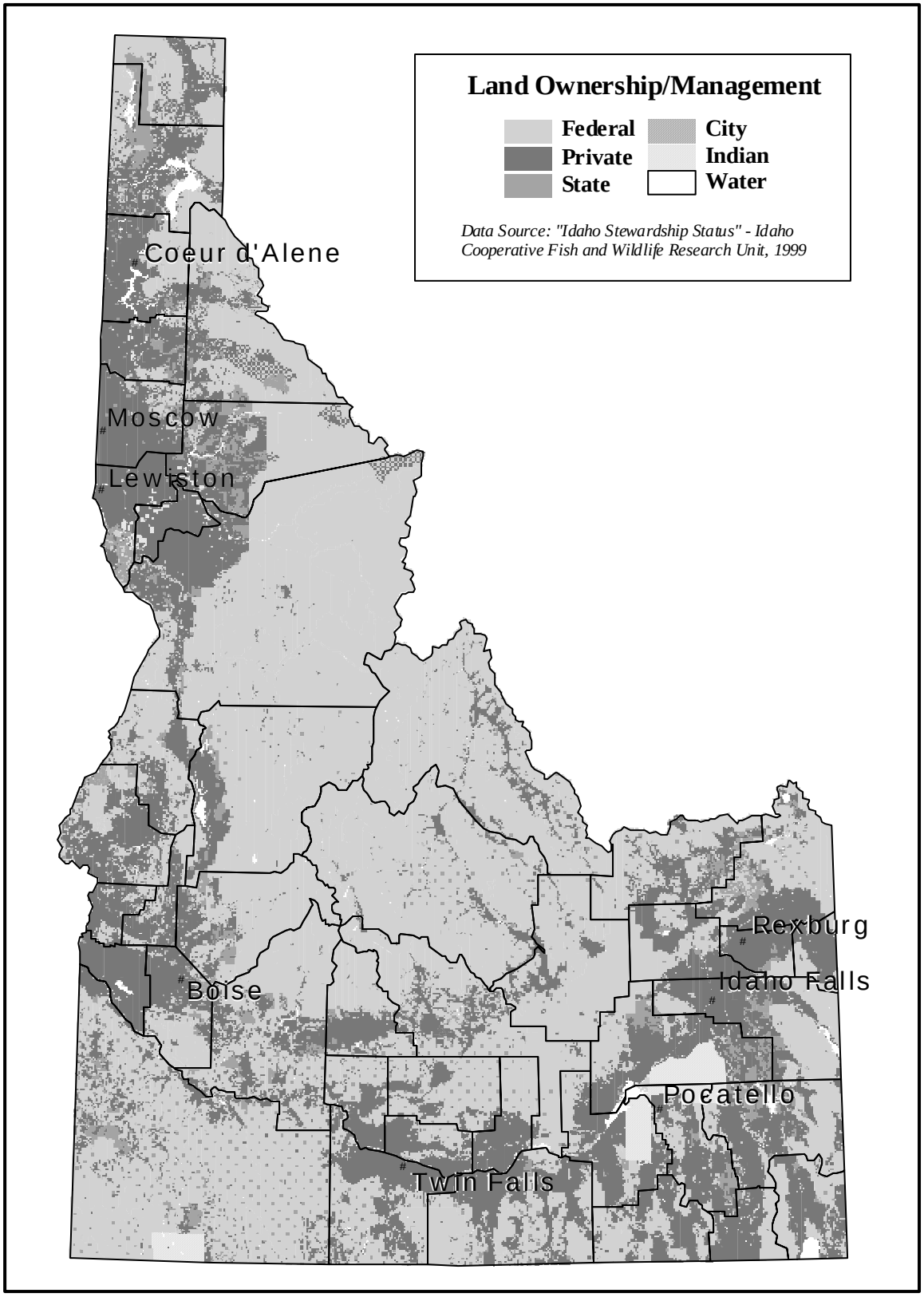


Figure 2 - Land Ownership in Idaho

Projected Occurrences

State-wide Assessment

While the frequency of past events gives some insight into future occurrences, "severity" is a better measure of the potential impact of each hazard on the state. Severity combines the frequency of each hazard, with measures of the probable impact of each event on lives, property, facilities, and the economy and environment. Table 9 lists the relative severity of each hazard anticipated to have a potential significant impact on the state.

A detailed discussion of projected future occurrences is included in each individual hazard section.

County-level Assessment

Appendix K lists the potential significance for each hazard for each county in the state. This information is derived from county hazard mitigation plans, local emergency management personnel, and state personnel.

Table 9 - Idaho Hazards Ranked by Potential Impact

Hazard	Potential Impact
Flood	
Urban/Wildland Interface Fire	
Earthquake	
Landsliding	
Avalanche	
Drought	
Lightning	
Severe Storm	
Volcanic Eruption/Ashfall	
Wind/Tornado	

Hazard Mitigation

Mitigation Strategies

Goals

These mitigation goals describe the underlying intent the Plan. They are broad statements of the desired outcomes of the Plan's implementation and the philosophy for the Plan's direction and execution. Together, they form the basis for evaluation of the Plan's success by offering a number of "yardsticks" to measure change from the status quo or pre-plan environment.

The State of Idaho's natural hazard mitigation goals are to:

- Save lives and reduce public exposure to risk.
- Reduce or prevent damage to public and private property.
- Reduce adverse environmental or natural resource impacts.
- Reduce the financial impact on the public.

Objectives

These mitigation objectives are the fundamental strategies that the Plan prescribes to achieve the mitigation goals. They are specific statements of how the goals will be realized through action at State and other levels. These objectives constitute a vision of the course for mitigation actions that is shared by all State agencies.

The State of Idaho's natural hazard mitigation objectives are to:

- Enhance coordination of Federal, State, and local agencies and consistency of hazard impact reduction policy.
- Increase knowledge of hazards, hazard mitigation approaches, and the effects of land uses, hazard impact reduction, post-disaster recovery, and resource management practices on natural and man-made environments and the risk and potential impact of the hazards.
- Reduce vulnerability to hazards and environmental impacts through coordination with growth management planning efforts, improved design and construction standards, and programs that address current at-risk development.
- Strengthen hazard preparedness, response, and education.

Mitigation Action Categories

For organization and planning, the recommended mitigation actions are categorized into five functional groups:

- Hazard Management
- Information/Education
- Infrastructure
- Regulatory
- Mapping & Analysis

Hazard Management actions directly reduce the community risk from a natural hazard event by reducing or eliminating the intensity or extent of the event. These include structural actions that physically alter the physical system and may also include acquisition actions that result in the responsible party taking direct control of elements of the physical system through purchase or condemnation. Examples include:

- Channel dredging;
- Construction of retaining walls in landslide prone areas; and,
- Vegetation management to reduce wildfire hazard in areas bordering urban development.

Information/Education actions inform the community at large, interested professionals, and elected officials about the risk and steps that can be taken to reduce it. These actions may be seen as a long-term investment in mitigation and may be integrated into other actions. Examples include:

- Public information brochures and direct mailing;
- Posting of interpretive materials at ongoing natural hazard events or probable sites (e.g. high-frequency floodplains and landslide sites).
- Incorporation of natural hazard awareness mitigation concepts into classroom studies; and,
- Public workshops reviewing previous disasters and steps for improvement.

Infrastructure actions directly reduce the community risk from a natural hazard event by developing new or modifying existing elements of the public infrastructure. These include structural actions that physically alter large and small elements of the community.

- Retrofitting highway overpasses to withstand earthquakes;
- Development of an emergency communication system;
- Buyout of vulnerable structures and land in the floodplain; and,
- Anchoring bookcases in schools, libraries, and offices.

Regulatory actions are legal controls, administrative systems, and other public sector functions established or revised to guide private and public actions that affect the community risk from natural hazard events. This includes actions that affect a change in an individual organization or group of organizations to allow them to conduct their operations more effectively. It also includes actions that encourage private and public actions that will reduce community risk. Such actions may seek to reduce the existing risk or control possible future increases in risk. Examples include:

- Adopting, and enforcing building codes and standards;
- Offering reduced premiums on flood insurance for "flood-proofed" structures;
- Establishing coordination of multiple agencies that share jurisdictions.
- Practicing sound land use planning based on known hazards; and,
- Controlling storm water discharge timing and location.

Mapping & Analysis actions develop a greater understanding of the nature, extent, and probable impact of the hazard. Such an understanding is the foundation for other, more "proactive" actions. Examples include:

- Revision of flood inundation maps to reflect changes in river channel geometry;
- Vegetation mapping to determine probable fire extent and vulnerable structures; and,
- Conduct a regional landslide assessment based on geology and hydrology.

The Context for Action

The Plan works to coordinate a reduction in damages throughout Idaho from natural hazards. Regrettably, no plan will totally eliminate losses—floods, fires, earthquakes, and other natural hazards will remain a part of life in our state. As long as people occupy floodplains and other hazardous areas, they will remain at risk. In fact, given the continued population and economic growth in our state, it is likely that damages will increase, even if the Plan is carried out in good faith.

The damages will not, however, increase as dramatically as they would without implementation of loss reduction strategies. The actions and measures listed here will help to reduce losses to life, property, infrastructure, and resources and insure that disasters inflict the minimum possible amount of damage.

Further, the State clearly has a duty to take what action is feasible given the historical and potential impact of natural hazards within the state. Failure to act would be unacceptable to Idaho's citizens and could place the State in a position of liability.

Recommended State-wide Hazard Mitigation Actions

Introduction

In the following sections, *Recommended State-wide Hazard Mitigation Actions* describe the mechanisms for implementation of the above goals and objectives in the context of the given hazard. Through these actions the Plan coordinates State agencies and resources to be dedicated toward disaster impact reduction.

The mitigation actions are described in detail in the following chapter *Recommended Mitigation Actions*. Specific tasks, background, and implementation responsibility and status are listed. The chapter also identifies high-priority actions for expedited implementation.

A number of mitigation actions apply to many, or all, hazards and subsequently present a comprehensive approach to disaster impact reduction. The actions listed in *Comprehensive Actions* below are broadly applicable. They are listed here rather than in each hazard section.

Comprehensive Actions

Hazard Management

SHMP-HM19	Mitigate Natural Hazard Risk for All State Facilities and Infrastructure

Information/Education

SHMP-IE19	Develop a Post-Disaster Public Information Campaign
SHMP-IE20	Work with Local Officials to Develop Their Understanding of Natural Hazard Issues and Ability to Perform Emergency Management and Mitigation Functions Effectively
SHMP-IE21	Establish a Natural Hazard Awareness Week in Idaho
SHMP-IE22	Develop and Publish a Natural Hazard Information WWW Site
SHMP-IE23	Encourage Individual Mitigation Efforts
SHMP-IE24	Develop a Natural Hazard Awareness and Mitigation Education Program for State Agency Officials and Employees and Private Critical Facility Personnel

Regulatory

SHMP-RE11	Develop a Mitigation Project Prioritization Method
SHMP-RE12	Support Local Natural Hazard Mitigation Projects

SHMP-RE13	Require Disclosure of Natural Hazard Conditions in Real Estate Transactions
SHMP-RE14	Identify Potential Funding Gaps in Mitigation Activities
SHMP-RE15	Support Improved Land Use Management by Local Governments
SHMP-RE16	Improve Intergovernmental and Public/Private Coordination during Disaster Response and Mitigation
SHMP-RE17	Require Local Governments to Consider Natural Hazards in Land Use Planning Decisions
SHMP-RE18	Improving State Permitting Procedures
SHMP-RE19	Increase Mitigation Funding
SHMP-RE20	Form a State Interagency Mitigation Commission

Mapping & Analysis

SHMP-MA10	Improve Rural Area Mapping Capabilities
SHMP-MA11	Provide Hazard Assessment and Mapping Information to Local Jurisdictions

FLOODING

Hazard Assessment

Fundamentals

Types of Flooding

Flood events may be classified under three general categories:

- Riverine Flooding
- Flash Flooding
- Ice/Debris Jam Flooding

Riverine flooding includes those events that are classically thought of as flooding; i.e., a gradual rise of volume of a stream until that stream exceeds its normal channel and spills unto adjacent lands. Such events are generally associated with major meteorological events: spring runoff, winter rain/snowmelt events, and ice jams. Riverine floods typically have low velocities, affect large land areas, and persist for a prolonged period.

In contrast, flash floods may have a higher velocity in a smaller area and may recede relatively quickly. Such floods are caused by the introduction of a large amount of water into a limited area (e.g., extreme precipitation events in watersheds less than 50 square miles), crest quickly (e.g., eight hours or less), and generally occur in hilly or otherwise confined terrain. Flash floods occur in both urban and rural settings, principally along smaller rivers and drainage ways that do not typically carry large amounts of water.

Occasionally, floating debris or ice can accumulate at a natural or man-made obstruction and restrict the flow of water. Ice and debris jams can result in two types of flooding:

- Water held back by the ice jam or debris dam can cause flooding upstream, inundating a large area and often depositing ice or other debris which remains after the waters have receded. This inundation may occur well outside of

may occur well outside of the normal floodplain.

- High velocity flooding can occur downstream when the jam breaks. These flood waters can have great destruction potential due to the ice and debris load that they carry.

Flooding Definitions

Floods vary greatly in frequency and magnitude. Small flood events occur much more frequently than large, devastating events. Statistical analysis of past flood events can be used to establish the likely magnitude and recurrence intervals (period between similar events) of future events. The most commonly reported flood magnitude measure is the "base flood." This is the magnitude of flood having a one-percent chance of being equaled or exceeded in any given year. Although unlikely, "base floods" can occur in any year, even successive ones. This magnitude is also referred to as the "100-year Flood" or "Regulatory Flood" by State government.

The areas adjacent to the channel that normally carries water is referred to as the floodplain. Like "disaster," this term has two meanings, practical and regulatory. In practical terms, the floodplain is the area that is inundated by flood waters and is obviously a somewhat fluid concept based on the magnitude of the flood. Where the surface of the land is relatively undisturbed, flood-prone areas can be recognized by a well-defined natural flat "floodplain", by natural levees along stream banks, by alluvial fans, abandoned channel meanders, or by soil types that are associated with the floodplains. In altered or urbanized areas, these features will be less distinct; they may be obscured or removed by development. Further, where structures have been placed in the floodplain, the processes may have been so altered that these features no longer accurately define the floodplain.

In regulatory terms, the floodplain is the area that is under the control of floodplain regulations and programs (such as the National Flood Insurance Program). Idaho State Code defines the floodplain as:

That land that has been or may be covered by floodwaters, or is surrounded by floodwater and inaccessible, during the occurrence of the regulatory flood. [13]

The floodway, a subdivision of the floodplain, is of special regulatory interest. More stringent regulations are often imposed in the floodway as changes here can have greater impact on the overall flood regime than in the remainder of the floodplain (the "flood fringe"). The floodway is defined as:

The channel of the river or stream and those portions of the floodplain adjoining the channel required to discharge and store the floodwater or flood flows associated with the regulatory flood.[14]

Application of these terms and concepts to flash and ice/debris jam break floods can be difficult. The term "inundation zone" may be used in place of floodplain and should be considered analogous. Like floodplains, inundation zones may be determined by projection of the anticipated volume of water (e.g., runoff from the "base" storm, storage capacity of the dam that may fail, or excess runoff not conducted by a storm water system). Historical inundation zones may be observed through field study of terrain features and vegetation, but, although they may be associated with recognizable terrain features such as canyons or gulches, areas subject to these floods are often less obvious than those located on a typical riverine floodplain.

Flood-related Damages

Floods have been the most serious, devastating, and costly natural hazard to affect Idaho. Most Idaho residents live near rivers which are subject to periodic flooding. Floods in Idaho frequently damage roads, farmlands, and structures, often disrupt lives and businesses, and occasionally cause loss of lives. A few streams in Idaho are subject to almost annual

[13] Idaho State Code 46-1021.
[14] Ibid.

flooding, but in most areas damaging floods are much less frequent.

Historically, the greatest impact has been to the northern and north central parts of the state where communities are vulnerable to flooding from the many rivers, lakes and creeks in the area. The steep, mountainous terrain creates a flood-prone environment and development is often confined to areas adjacent to stream channels. Significant events and disasters have occurred throughout the state, though, and few areas are truly flood-free. Irrigation systems and small streams that flow through communities can bring in floodwater to areas that would normally be free of such (even or because of effective control in the main channel).

The nature and magnitude of flood-related damages are dependent on:

- Flow Volume and Velocity - High volume and/or velocity flows carry huge mechanical forces and are capable of damaging even substantial structures.
- Duration - Long duration floods of even low volume can cause great damages due to prolonged inundation (e.g., crop damage).
- Bank Stability - Bank erosion can alter channel paths and result in substantial losses of property.
- Sediment Load and In-stream Debris - Siltation from sediment transport and deposition may decrease the carrying capacity of the channel exacerbating the current and future flood events. Siltation may also decrease reservoir storage capacity, degrade fish and wildlife habitat, change the course of a stream, or introduce chemicals into the stream. In-stream debris increases the likelihood of mechanical damage and may raise flood levels when jams form.
- Secondary Hazards - Secondary hazards associated with flooding include landsliding, structural fires, and disease.

Generally, flash floods represent the greatest risks to life and limb due to the rapid onset, the potentially high velocity of water, and the huge debris load carried by floodwaters. When conditions allow, flash floods may arrive as fast moving walls of debris, mud, and water. A series of fast moving storms may produce more than one flood crest and the sudden destruction of structures and the washout of access routes may result in the loss of life. Flash floods are a major cause of weather-related deaths in the United States.

The possibility for injury and death from flash floods is heightened because they are so uncommon that people do not recognize the danger. For example, the rapid rise in water level and force may cause motorists to underestimate the depth and velocity of floodwaters, causing stalled and flooded vehicles and drowning; fifty percent of all flash-flood fatalities are vehicle related.

Riverine Flooding

Factors Contributing to Riverine Flooding

Simply put, riverine flooding occurs when water leaves the channels, lakes, ponds, and other confinements where we expect it to stay; flooding-related disasters occur when human property and lives are impacted by that water. An understanding of the roles of weather (precipitation, runoff, and riverine ice formation), landscape, and human development in the floodplain is therefore the key to understanding and controlling flood-related disasters.

Meteorological Factors. Idaho experiences riverine flooding from two distinct types of meteorological events: spring runoff and winter rain/snowmelt events.

The major source of flood waters in Idaho is normal spring snow melt. As spring melt is a “natural” condition, the stream channel is defined by the features established during the average spring high flow. Small flow peaks exceeding this level and the stream’s occupation of the floodplain are common events.

Unusually heavy snowpacks or unusual spring temperature regimes (e.g., prolonged warmth) may result in the generation of runoff volumes significantly greater than can be conveyed by

the stream and river channels. Such floods are the ones that lead to widespread damage and disasters. Floods caused by spring snow melt tend to last for a period of several days to several weeks, longer than the floods caused by other meteorological sources.

Floods that result from rainfall on frozen ground in the winter, or rainfall associated with a warm, regional frontal system that rapidly melts snow at low and intermediate altitudes, can be the most severe. Both of these situations quickly introduce large quantities of water into the stream channel system, easily overloading its capacity.

On small drainages, the most severe floods are usually a result of rainfall on frozen ground but moderate quantities of warm rainfall on a snow pack, especially for one or more days, can also result in rapid runoff and flooding in streams and small rivers. Although meteorological conditions favorable for short-duration warm rainfall are common, conditions for long-duration warm rainfall are relatively rare. Occasionally, however, the polar front becomes situated along a line from Hawaii through Oregon, and warm, moist, unstable air moves into the region. Most winter floods develop under these conditions (as was the case with the northern Idaho floods of 1996).

Weather and long-term climate forecasting can help foresee the likelihood of unusual precipitation patterns and temperature regimes (leading to snowmelt or ice formation). In general, the meteorological factors leading to flooding are well understood. They are also out of human control, so flood mitigation must address the other contributing factors.

Landscape Factors. The nature and extent of a flood event is the result of the hydrologic response of the landscape. Factors that affect this hydrologic response include soil texture and permeability, land cover and vegetation, and land use and land management practices. Precipitation and snow melt, known collectively as runoff, follow one of three paths, or a combination of these paths, from the point of origin to a stream or depression: overland flow, shallow subsurface flow, or deep subsurface ("ground water") flow. Each of these paths delivers water in differing quantities and rates. The character of the landscape will influence the relative allocation of the runoff and will, accordingly, affect the hydrologic response.

For example, a parking lot has an impervious (nonporous) surface so all of the precipitation landing on this surface leaves as an overland flow. Such flow results in a rapid and complete delivery of the runoff to the destination. In contrast, a forested area with well developed soils offers a highly porous surface and a significant portion of the runoff enters a deep subsurface flow path. Such flow is characteristically slow and some of the runoff may be intercepted (such as through uptake by plants). These two surfaces – paved and forested – are radically different in hydrologic response; consequently, landscape changes will modify the hydrologic response of an area, especially if they occur over a wide region.

As with meteorological factors, the capacity of the landscape to accommodate additional water can also be forecast through a water balance analysis comparing rainfall and snow pack, stream flow, and reservoir storage data. Although the processes are well understood, forecasting can be difficult and margins of safety are required to respond to the unforeseen.

Unlike precipitation and ice formation, steps can be taken to mitigate flooding through manipulation or maintenance of these factors. Insufficient natural water storage capacity and changes to the landscape can be offset through water storage and conveyance systems that run the gamut from highly engineered structures to constructed wetlands.

Careful planning of land use can build on the natural strengths of the hydrologic response. Revegetation of burned slopes diverts overland flow (fast and flood producing) to subsurface flow (slower and flood moderating).

Mitigation, though, is not the only public goal affecting the landscape and may find itself at odds when other pressing socio-economic concerns.

Development Factors.[15] A good deal is known concerning the mechanisms behind flooding; consequently, floods generally come with warnings and flood waters rarely go where they are totally unexpected by experts. Those warnings are not always heeded, though, and despite the predictability, flood damages continue.

In many cases, the failure to recognize or acknowledge the extent of the natural hydrologic forces in an area has led to development and occupation of areas that can clearly be expected to be inundated on a regular basis. Most streams overflow what are commonly regarded as their channels at least once every one and one-half to two years. Despite this, communities are often surprised when the stream leaves its channel to occupy its floodplain. A past reliance on structural means to control floodwaters and "reclaim" portions of the floodplain has also contributed to inappropriate development and occupation and continued flood-related damages.

Unlike the weather and the landscape, this flood-contributing factor can be controlled. Development and occupation of the floodplain places individuals and property at risk. Such use can also increase the probability and severity of flood events (and consequent damage) downstream by reducing the water storage capacity of the floodplain, or by pushing the water further from the channel or in larger quantities downstream.

State Inventory of Past Events

Table 10 lists the major riverine flood events prior to 1976 as determined by the U.S. Geological Survey.

[15] Development, as defined by Idaho State Code 46-1021, is: Any man-made change to improved or unimproved real estate, including, but not limited to, the construction of buildings, structures or accessory structures, or the construction of additions or substantial improvements to buildings, structures, or accessory structures; the placement of mobile homes; mining, dredging, filling, grading, paving, excavation or drilling operations; and the deposition or extraction of materials; specifically including the construction of dikes, berms and levees.

Table 10 - Major Riverine Flood Events Prior to 1976

Year	Area Affected
1894	State
1927	Upper Snake River Basin
1933	Spokane River Basin
1943	Boise and Payette basins
1948	Northern and western Idaho
1955	Southwest Idaho
1959	Boise River Basin
1962	Southern and eastern Idaho
1963	Portneuf and Clearwater basins
1964	State-wide at low elevations
1974	Northern and central Idaho
1974	State-wide

Three of the most notable events occurred in 1933, 1964, and 1974. In 1933, warm rain on low elevation snow led to flooding in the Panhandle region and especially on the Coeur d'Alene River at Coeur d'Alene and the St. Joe River at St. Maries. Railroad tracks were under six feet of water, livestock drowned, all the families had to leave their homes, and in many cases, their houses were washed down the river. Levees were destroyed and the entire St. Joe valley became one vast lake. (Additional flooding occurred in the area in 1946, 1948, 1976, and 1996, despite levee construction by the Army Corps of Engineers in 1942.)

At the end of December 1964, warm rains fell on snow causing the Payette, Clearwater, Big and Little Wood Rivers to Flood. The Payette River rose to record levels that flooded irrigation ditches and farmland; estimated damage was $21 million and two deaths were reported.

Significant flooding struck the St. Joe River valley again in January 1974. Damages were estimated at 5.5 million dollars; $4 million to public facilities (including roads and utilities) and $1.5 million to private property.

Table 11 lists the state flood-related disaster declarations for the period 1976-2000. The three Federally-declared Disasters during this period are summarized here.

Panhandle Floods – 1996. A combination of existing snow, 10 inches of new snow and single-digit temperatures the last week of January, 1996, caused ice to form on many rivers. This was followed by a warming pattern the first week of February and resulted in flooding in the northern Panhandle counties beginning on February 6.

On February 11, 1996, the President declared a major disaster in the State of Idaho (designated *DR-1102*). Ten Counties and the Nez Perce Indian reservation were declared eligible for assistance. As of February 1, 2001, assistance included $22,635,325 in public assistance, $71,639 in individual assistance, $301,081 from the Natural Resource Conservation Service (NRCS), and $5,022,353 in hazard mitigation grants.

In Clearwater County, 167 homes were damaged or destroyed; forty commercial buildings were damaged; one church was destroyed and two were damaged. In the Coeur d'Alene basin (Kootenai and Shoshone counties), it was reported that residents were stranded by the flood waters and had to be contacted by boat, ATVs or helicopters.

St Maries, the county seat of Benewah County, saw heavy damage despite an extensive levee system; over 100 homes and 19 commercial buildings were flooded. At one mill, one million board feet of lumber and a drying kiln were lost. Latah County damage included an estimated $1.6 million of damages to the University of Idaho.

Nez Perce County had damage near the community of Peck where 11 homes were destroyed, six had major damage and two had minor damage. Extensive damage was also reported on the Nez Perce Indian Reservation at Lapwai.

Districts 1 and 2 of the Idaho Transportation Department were hit hard by the disaster. In District 1, major highway damage occurred on U.S. 97 at Carlin Bay; U.S. 2 was closed at Dover where water covered a quarter mile of highway. Idaho 200 and 3 had damage. Interstate 90 was closed temporarily at Pinehurst and Cataldo. Idaho 6 was closed at Harvard Hill where approximately two miles of road was damaged.

In District 2, U.S. 95 had ten miles of damage; it was closed south of Lewiston where the road washed out in many locations. The stretch of road north of Lewiston at the Palouse Bridge was also closed. Damage occurred on U.S. 12 east between Cottonwood Creek and Orofino; Idaho 3 was closed east of Arrow Junction to Juliaetta with a washout area that was 400 feet long and 12 feet deep. Idaho 11 and 162 was closed in areas due to rock and mudslides. Idaho 6, 7, 9, and 64 were also damaged and portions were closed for a period of time.

Northern and Central Floods – 1996-97. During late December, 1996, above-normal snowfall occurred in Northern and Central Idaho. This event was quickly followed by a warm, moist current of air from the subtropics that dumped warm rain on melting snow. The melting snow and heavy rains overwhelmed rivers and their tributaries, leading to severe flooding and widespread landslides mainly in the West-Central region of the state.

Table 11 – Riverine Flood-related State Disaster Declarations 1976-2000			
Year	**Month**	**Federal**	**Counties Affected**
1979	January		Bingham, Washington
	February		Canyon, Washington
	February		Nez Perce
1980	March		Power, Oneida
1982	February		Bonner, Washington
	April		Blaine
1983	June		Jefferson
1984	May		Cassia
	May		Bannock, Twin Falls
	June		Jefferson
	June		Owyhee
	December		Lemhi, Butte
1985	January		Cassia
1986	January		Canyon, Payette, Washington
	February		Owyhee
	February		Boise
	June		Boise, Buster
1990	September		Elmore
1991	April		Bonner
1994	December		North Idaho
1996	February	X	Benewah, Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Lewis, Nez Perce, Shoshone
	May		Payette
	June		Boundary, Kootenai, Latah, Shoshone
1996-1997	November - January	X	Adams, Benewah, Boise, Bonner, Boundary, Clearwater, Elmore, Gem, Idaho, Kootenai, Latah, Nez Perce, Owyhee, Payette, Shoshone, Valley, Washington
1997	March – June	X	Benewah, Bingham, Bonner, Bonneville, Boundary, Butte, Custer, Fremont, Jefferson, Kootenai, Madison, Shoshone

On January 4, 1997, the President declared a major disaster (designated as *DR-1154*) in the State of Idaho due to severe winter storms, flooding, mud, and landslides. Eighteen counties were declared eligible for Federal assistance. As of February 1, 2001, assistance included $19,404,105 in public assistance, $39,988 in individual assistance, $125,937 from the NRCS, $576,314 from the Army Corps of Engineers, and $5,593,892 in hazard mitigation grants.

Flood damage was widespread. Railroad tracks and trestles were washed out in dozens of locations. Substantial gravel and silt deposits left by flood waters accumulated on agricultural lands; cattle were stranded and farm equipment was submerged and damaged. Pesticide containers and fuel tanks were disturbed by the sudden flooding on the Payette and Weiser Rivers.

In the City of Payette, approximately 120 homes and 30 businesses were flooded; most problems resulted from a levee break that resulted in floodwaters two to three feet above the base flood elevation. In Gem County, fourteen levees were damaged, including all three levees in Emmett, which showed large cracks and sections slumped into the river.

On the Weiser River, irrigation canals carried floodwaters to portions of the floodplain that would not have normally been flooded by the river itself; some homes and businesses in Weiser were damaged or destroyed from floodwaters conveyed by these irrigation systems.

US 55 was restricted for one week and US 95 experienced 11 washouts that isolated residents for days. McCall was isolated, suffering severe economic hardship due to disruption of its winter recreation activities.

Northern and Southeastern Floods - 1997. In early March 1997, northern Idaho received 12 to 18 inches of snow on top of an existing snowpack that exceeded 150-170% of average. A rainstorm followed which resulted in a rapid snow melt. Precipitation for the month of March in this area was 187% of normal. The resulting flooding and mudslides lasted for an extended period and damaged many public facilities, including severe impacts to county road systems due to washouts. Additionally, hazardous material contaminants were identified in the Kellogg area. The President issued a Federal Disaster declaration (DR-1177) on June 13, 1997 for Benewah, Bonner, Boundary, Kootenai, and Shoshone Counties.

The Snake River Basin also received a significant amount of snowfall during the winter 1996-97, with the snowpack exceeding 250% of normal in some higher elevations. By May, the substantial snowpack in the higher elevations along the continental divide started to produce above normal runoff. In order to accommodate the rapid accumulation, the Bureau of Reclamation began increasing its releases from Palisades Reservoir. By June 11, the flows coming out of the reservoir coupled with the high tributary discharges produced the highest flows on the Snake River since 1918.

At its peak, the Snake River flooded as far as a mile from its banks, and many places were under five feet of water. On June 16, flood fights were conducted on the Snake River at Roberts where voluntary evacuations were in effect. River levels were close to overtopping existing flood control levees and flooding of agricultural lands began far from the main channel as irrigation canals overflowed their banks. Numerous closures of county roads and state highways from water and damage to bridges, especially in Jefferson County, impacted transportation as well as response activities. On June 17, flood fighting efforts continued in several small towns, including Menan, Firth, Blackfoot, and Labell. On June 18, Interstate 15 was closed for nearly twenty miles between Shelley and Blackfoot.

On July 7, 1997, six counties in Southeastern Idaho (Bingham, Bonneville, Custer, Fremont, Jefferson, and Madison) were added to the five northern counties already declared under DR-1177. On July 25, Butte County was also declared. As of February 1, 2001, total assistance included $11,365,667 in public assistance, $8,054 in individual assistance,

$251,054 from the NRCS, and $1,691,458 in hazard mitigation grants.

The State estimated that approximately 500 people were displaced from their homes in Jefferson and Bingham counties. Agricultural officials estimated that more than 50,000 acres of farm, pasture, and cropland had been flooded; 30,000 in Bingham County alone.

Projected Occurrences

Figure 3 shows major riverine flood susceptible areas.

Snake River Basin. Only a relatively small portion of the Snake River Basin is susceptible to flooding; however, many of the flood prone areas are intensively populated. Flooding can potential cause extensive damage to land and buildings, highways, railroads, irrigation facilities, and utilities. Snake River floods will generally occur in the months April through June, primarily from snow melt in the upper basin. Late spring or summer snow melt floods typically occur as a series of high flows for periods of days or weeks. They can be compounded by warm spring rains that increase snow melt rates and contribute directly to runoff.

Flood damage along the Snake River, for the most part, will be confined to the flood plain between Heise and American Falls Reservoir. The safe channel capacity of the Snake River in this reach varies from 15,000 cfs to 30,000 cfs.

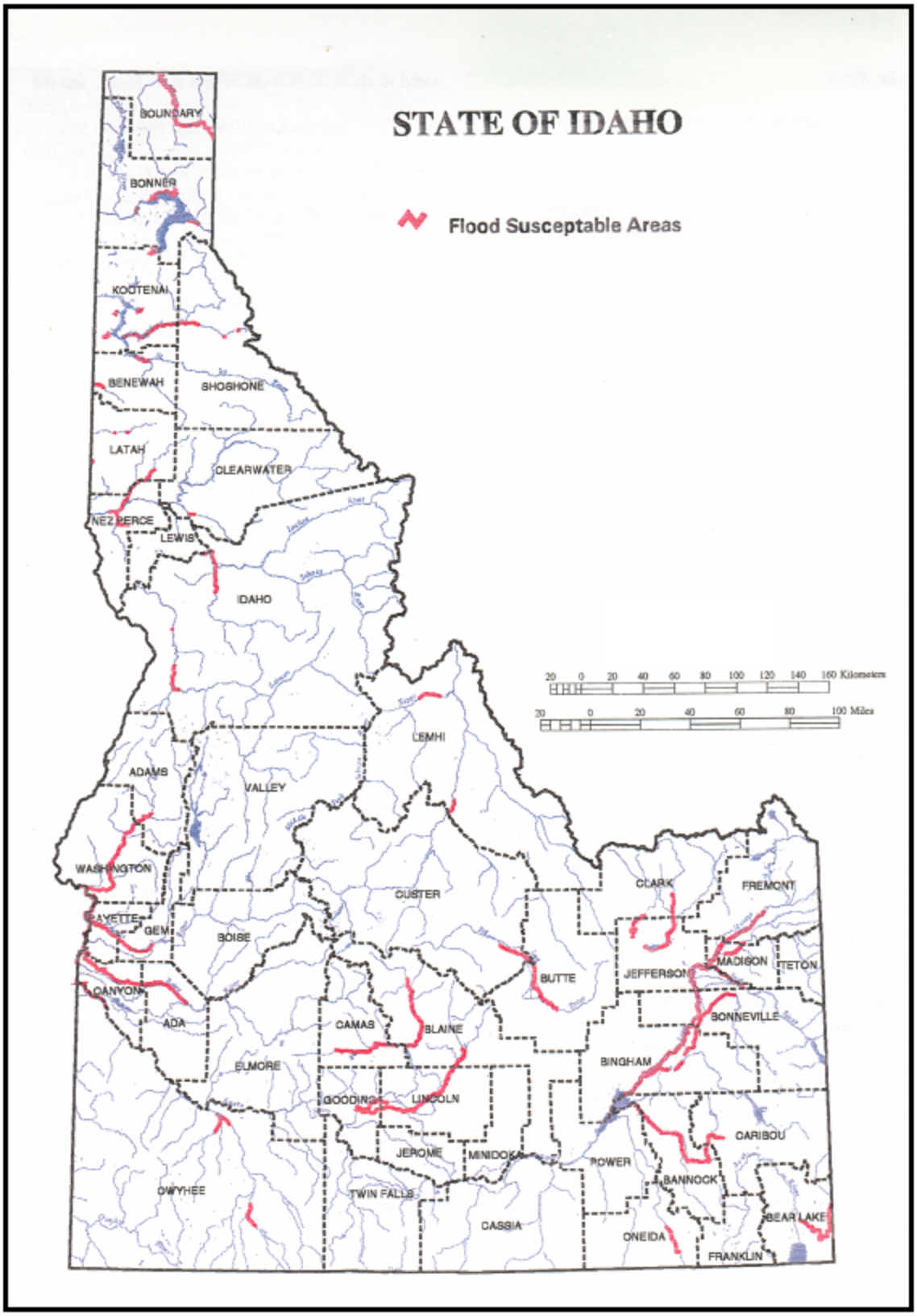
Regulation of the Snake River and some tributaries can significantly reduce natural flood flows through dams constructed for flood control and other purposes. Reservoirs that function for other purposes can reduce flood flows through informal flood control operation or incidental storage of flood waters. Major dams in this region include Jackson Lake and Palisades.

Levees protect flood prone land between Heise and Roberts, near Shelley, and near Blackfoot. However, the stream bed materials, low banks, and gradient induce river meanders. Major channel shifts could unpredictably impinge upon the levees.

American Falls affords major regulation of Snake River flood flows, although little flood damage is likely from the dam to downstream to Milner. This stretch of the river consists of a series of irrigation diversion pools and canyon reaches. The Snake River, between Milner Dam and King Hill, flows through a deep narrow canyon cut in the Snake River Plain. Developed land adjoining the river is generally above the elevation of flood discharge. Idaho Power's reservoirs, or pools, within the reach are for power generation and have no flood storage allocation. There are no levees below American Falls Dam.

Most of the Snake River between King Hill and the Boise River confluence is located in a canyon with little flood plain for development. Storage reservoirs and diversions in the Upper Snake Basin can reduce flood flows at the Swan Falls gage by approximately 40,000 cfs.

Major Snake River Tributaries. In the Henrys Fork area, flooding will generally result from spring snow melt. Flood damage is possible along the lower twenty-two miles of the Henrys Fork and along the Teton River near Rexburg. Upstream irrigation reservoirs and large irrigation diversions can reduce the magnitude of spring and summer flood peaks on the Henrys Fork. However, the bank-full capacity of the lower Henrys Fork is approximately 5,000 cfs, and a flow of 9,000 cfs can cause a general inundation of this reach. Floods on the Teton River are almost an annual occurrence.



Source: Idaho Department of Water Resources, 1997.

Figure 3 - Areas Susceptible to Flooding

Camas and Beaver Creeks are sources of surface inflow to Mud Lake, which has no effective outlet other than irrigation canals, evaporation, and seepage. Lands along Camas Creek near the lake and along the south side of the lake are susceptible to flooding. If the volume of inflow were to exceed the available storage capacity of the lake, locally constructed dikes around the lake might fail and permit flooding of farm areas south of the lake. The Mud Lake flood plain is principally in crops. Portions of residential and associated developments in the communities of Terreton and Mud Lake, on the fringe of the flood plain, may suffer minor damages under extreme flood conditions. Flooding can occur in reaches along the entire length of the Portneuf River downstream from Portneuf Reservoir and along Marsh Creek. Protection of the Pocatello area is afforded by a rectangular concrete channel through the city with riveted levees on both ends where development is less extensive. A 1988 Army Corps of Engineers Preliminary Report on the Portneuf River examined constructing multiple purpose storage reservoirs, and enlarging the river channel. The study found that these proposals were not economically justified.

Flood damage in the Wood River basin is most likely in a reach extending from Ketchum to Bellevue, near Gooding, and at Carey and Shoshone. The agricultural lands subject to flooding in the Big and Little Wood valleys are used primarily for pasture, hay, and grains.

In the Boise River Basin the magnitude of flood flows have been diminished by irrigation diversions and storage reservoirs. However, agricultural lands downstream of Boise and flood plain home sites in the city are still subject to periodic flooding in high runoff.

Major flooding of the Weiser River is also possible. The fairgrounds at the town of Cambridge and a portion of the area south of town are located in the river's flood plain. The agricultural enterprises in the lower thirteen river miles of the Weiser River, from the Galloway Diversion to the mouth of the river near the City of Weiser, are susceptible to flooding. Incidental storage in Crane Creek and Lost Valley reservoirs can reduce peak flows by an estimated 3,600 cfs.

Flood flows in the Clearwater Basin can be expected to damage residential and commercial buildings in the cities of Orofino, Stites, and Kooskia on the main stem of the Clearwater. Towns on tributary streams, are also subject to damages. Highway and railroad bridges and roadbeds can be undercut and washed out. Lumber operations are also at risk.

Flood control is an important function of the Dworshak project on the North Fork Clearwater. The reservoir is managed to alleviate flooding below Ahsahka, and is a part of the regional flood control system of the Columbia River Basin. Dworshak regulation is considered essential in limiting flood waters to 150,000 cfs or less through Lewiston.

Bear River Basin. Spring snow melt flooding in the Bear River Basin can exceeds stream channel capacity, and overflow onto adjacent low lands. More serious damage may be expected when heavy rain falls on frozen ground and/or a heavy snow pack. Thunderstorms are common during the summer and fall months, and these may produce localized cloudburst flooding. The total volume of water produced by this type of storm is relatively small, although the instantaneous runoff rate is high.

PacifiCorp's regulation of flows at Bear Lake has reduced the impact of flooding virtually every year on the main stem of the Bear River below Bear Lake. Bear Lake is operated to provide an annual pre-runoff storage volume equal to twice the average annual runoff. The Corps of Engineers (1991) estimated average annual damages from flooding, and analyzed structural control measures in the basin. Most of the damage from floods can be expected to occur on agricultural land and property.

Panhandle Rivers. Flood prone lands constitute a significant portion of the Panhandle basins. The Spokane, Kootenai, and Pend Oreille basins have a long history of major flood events. However, the greatest potential damage is usually not along major rivers, but

along tributary streams. Minor tributaries have steep gradients and damages are generally the result of flash floods. Placer Creek, a tributary of the South Fork Coeur d'Alene River, places the town of Wallace at risk (flooding has occurred seven times in the last century).

In the Spokane River Basin flooding is expected mainly along the low lying lands adjacent to tributary streams above Coeur d'Alene Lake in the Coeur d'Alene and St. Joe River valleys. Past property damage around Coeur d'Alene Lake has been negligible, but large areas may be inundated.

The Spokane River Basin above Coeur d'Alene Lake is unregulated by storage structures. About 55 miles of levees along the lower Coeur d'Alene River, the St. Joe River, Pine Creek, and other minor tributaries protect over 4,000 acres of land adjacent to rivers and streams from flood events. However, levees in the vicinity of St. Maries have failed and may do so again. A levee at Coeur d'Alene protects the city against high lake levels.

A melting snow pack is the most likely source for major flooding on the Kootenai River. Libby Dam regulation can control all but about one percent of floods originating from the Kootenai River. A base flood can be controlled by the dam to a 27-foot stage at Bonners Ferry. Levees have been constructed at many locations on both major and minor streams in the basin. Over 95 miles of levees protect 32,000 acres along 51 river miles in the Idaho portion of the basin. Levees protecting Kootenai Flats are effective up to a river stage of 35 feet at Bonners Ferry.

Flooding in the Pend Oreille Basin may occur along the river lowlands and tributaries. Damages would likely be confined largely to grain crops and pasture land, although some low lying road and buildings may be affected around Lake Pend Oreille. Calispell Creek, a tributary of the Pend Oreille, can produce major flooding events.

Flash Flooding

Factors Contributing to Flash Flooding

There are three types of flash flooding:

- Extreme precipitation and runoff events.
- Inadequate urban drainage systems overwhelmed by small intense rainstorms.
- Dam failures.

Debris flows are hazards that are closely related to flash floods but are more commonly considered as a type of earth movement (a "geotechnical" hazard). They are covered in this document in the chapter on Landslides.

Extreme Precipitation and Runoff Events. There are two types of weather events which may lead to flash flooding:

- Significant rainfall and/or snowmelt on frozen ground in the winter and early spring months.
- High intensity thunderstorms, usually during the summer months.

Flash floods from thunderstorms do not occur as frequently as those from general rain and snowmelt conditions but are far more severe.

The onset of these flash floods varies from slow to very quick and is dependent on the intensity and duration of the precipitation and the soil types, vegetation, topography, and slope of the basin. When intensive rainfall occurs immediately above developed areas, the flooding may occur in a matter of minutes. Sandy soils and sparse vegetation, especially recently burned areas, are conducive to flash flooding. Mountainous areas are especially susceptible to damaging flash floods, as steep topography may funnel runoff into a narrow canyon. A flash flood can occur on any terrain, though, when extreme amounts of precipitation accumulate more rapidly than the terrain can allow runoff.

Inadequate Urban Drainage Systems. Flash flooding in urban environments is an increasingly serious problem. Urban areas are susceptible to flash floods because a high percentage

of the surface area is composed of impervious streets, roofs, and parking lots where runoff occurs very rapidly. This rapid runoff allows for an intense concentration in the storm water drainage system. When the system is overwhelmed (i.e., the amount of runoff exceeds the capacity of the system), excessive runoff travels through the streets and open spaces of the area. Typically, this surface runoff will be concentrated by the terrain with streets and other paved areas between buildings functioned much as canyons in mountainous areas. Flash floods on alluvial fans are attracting greater attention as the population living in hazardous areas continues to rise. Development in urban/wildland interface areas pose unique risks as flash floods may originate in the mountainous terrain and grow in intensity and severity as they enter the urban environment where vegetation has been removed, where bridges and culverts constrict flow, and where buildings and paving have greatly expanded impermeable surfaces.

Dam Failure. Like the flash floods described above, floods resulting from dam failures are characterized by sudden onset, unpredictable nature, high flow velocity, and potentially large debris load. Dam failures may result from design or construction errors or omissions, overfilling/overtopping, and damage resulting from landsliding, earthquakes, or other large forces.

State Inventory of Past Events

Extreme Precipitation and Runoff Events. Extreme precipitation and runoff event flash floods occur throughout the state at all times of the year. Many are relatively small and do little damage; these are not well recorded. The National Weather Service did, however, record 121 flash floods during the period of 1982-2000, or an average of 7 per year. A Bonner County flash flood in May, 1991, received a State Disaster declaration; Federal assistance was denied.

The largest precipitation-related flash flood in recent history occurred August 20, 1959, inundating about 50 blocks in Boise and several hundred acres of farmland with water, rocks, and mud. On August 22, 1995, approximately two inches of rain fell on recently burned mountainous terrain near the North Fork of the Boise River, 45 miles to the northeast of Boise. These heavy rains caused a wall of water, rocks, and mud to flow down several creeks into the North Fork of the Boise River and over roads and campgrounds covering several vehicles.

More recently, warm rain on snow lead to a significant flash flood event near Sandpoint in May, 1991. The torrents blew out large sections of the road leading to Schweitzer Basin ski area stranding dozens of people, contaminated the city's primary water supply, and heavily damaged the water treatment facility. The cost to cleanout and repair the water treatment facility ran to several hundred thousand dollars. A State Disaster declaration provided some assistance but without a Federal declaration the costs to the local community were very high.

On December 31, 1996 and January 1, 1997, warm heavy rain fell on extensive low elevation snow in Valley, Boise, Gem, Washington, and Adams Counties. The combination of rapid melting snow and the rain caused numerous mudslides and creeks to exceed their banks. Many roads, bridges, and railroads were washed out along with several homes. The community of South Banks was destroyed as mudslides carrying boulders the size of dump trucks and large trees bulldozed homes down to the canyon below.

It is important to remember that even "minor" events can take a toll in terms of loss of life and property. On July 30, 1996 after two hours of heavy rain on the slopes of Black Pine Peak in southeast Cassia County a flash flood swept across the east bound lanes of Interstate 84, forcing a vehicle off the highway into deep water in a roadside ditch. The vehicle rolled and was carried more that 1000 feet, and the driver was killed.

Inadequate Urban Drainage Systems. Minor flooding is a common occurrence in Idaho's cities. Climate, mountainous surroundings, and rapid growth have in some cases resulted in insufficient urban drainage systems. For

example, Pocatello is located at the mouth of the Portneuf Canyon with generally mountainous terrain bordering the city on the east and south. Showers and thundershowers in the late spring and summer may result in highly localized precipitation concentrations that overwhelm the urban drainage systems. Some level of flooding occurs in Pocatello nearly annually, typically in underpasses and other areas with limited natural drainage.

Although such flooding is often regarded as a mere inconvenience, significant damage can occur. In September, 1998, hundreds of homes in Idaho Falls were damaged when the 1.17 inches of rain that fell in twenty-four hours overwhelmed the drainage system. Most recently, flash flooding from severe thunderstorms resulted in basement-flooding in Pocatello in 1999.

Dam Failures. Dam failure-caused flooding is infrequent but can have significant consequences. Idaho has experienced two major dam failures in recent history, Teton Dam (1976) and Kirby Dam (1991). There have also been a number of "near-miss" incidents where disaster was averted; these are not discussed here.

Teton Dam Failure – 1976. On June 5, 1976, Teton Dam in Fremont County failed. An estimated 80 billion gallons of water were released into the Upper Snake River Valley from the reservoir. Devastating flooding occurred in Wilford, Sugar City, Rexburg and Roberts; additional significant flooding occurred in Idaho Falls and Blackfoot.

At the time of its failure, Teton Dam stood 305 feet high, with a crest length of 3,100 feet and a base width of 1,700 feet. The dam was a zoned earth-fill structure with a volume of approximately ten million cubic yards. Links in the embankment weakened the structure allowing the reservoir water to break through the dam, carrying away about four million cubic yards of fill and burying the power and pumping plant beneath debris. The flood waters threatened American Falls Dam downstream on the Snake River. Dam managers opened the outlet works on American Falls full bore to empty the Reservoir and to save American Falls Dam and the string of dams farther down the Snake River.

On June 6, President Gerald Ford declared Bingham, Bonneville, Fremont, Madison, and Jefferson Counties a Federal disaster area. Eleven deaths were attributed to the dam failure and subsequent flood. Estimates of monetary damages ranged as high as $2 billion; the Federal government eventually paid out over $300 million in claims.

Kirby Dam Failure – 1991. During the summer of 1990, it became apparent that the old log crib structure of the Kirby Dam near Atlanta had become unsound and was in jeopardy of failing. The possibility of failure was of special concern due to the large quantity of mine runoff and tailings that had collected behind the dam over the years. A strategy to stabilize the dam was developed by the Idaho Department of Water Resources and the U.S. Forest Service but was unsuccessful. On May 26, 1991, Kirby Dam collapsed, cutting off electrical power and blocking the primary access bridge to Atlanta. Contaminated sediments (containing arsenic, mercury and cadmium) were released into the Middle Fork of the Boise River.

Projected Occurrences

Extreme Precipitation and Runoff Events. Winter storm floods generally occur during the months of January through March. Thunderstorms may occur at any time of the year, although they are most common from March through September. Almost all Idaho flash floods occur during the afternoon and evening hours. Flash floods are more difficult to forecast than riverine floods as their likelihood is related to a number of dynamic factors. Precipitation extremes as well as vegetation, soil condition, and development all directly effect the probability of flash flooding. Areas with a history of flash floods or suitable terrain must be considered at-risk, especially after event such as wildland fires that predispose the areas to flash floods.

Inadequate Urban Drainage Systems. As stated above, minor flooding is a common oc-

currence in Idaho's cities as insufficient urban drainage systems are overwhelmed by intense, concentrated late-spring and summer precipitation. The majority of these events are "nuisances" resulting in traffic delays or detours and minor cleanup costs. On occasion, though, they result in major damage and loss of life. Rapid growth in Idaho's urban areas is expected to place continuing pressure on the urban drainage systems and an increase in the frequency and severity of this type of flash flooding may occur.

Dam Failures. Idaho has hundreds of dams located throughout the state, ranging from large government reclamation and private utility hydroelectric facilities to small privately-owned dams for local flood control or irrigation purposes. Between 1905 and 1930, many dams were built in the state to store water, primarily for irrigation. A second spurt of dam construction, primarily for power generation, between 1950 and 1969 significantly increased water storage capacity. A major concern is that the expected life of a dam is 75 years and many dams are either approaching or have exceeded this age. Dams, through either overtopping or outright failure, may pose significant risks to downstream communities.

Dam safety in Idaho is administered by the Idaho Department of Water Resources. Dams 10 feet or higher or which store more than 50 acre feet of water (as well as mining tailings impoundment structures) are regulated by IDWR. Every dam is inspected once every other year unless more frequent inspections are called for by safety concerns. IDWR uses a dam risk classification to identify potential losses and damages anticipated in downstream areas that could be attributable to failure of a dam during typical flow conditions.[16] The risk categories are:

- Low Risk: No permanent structures for human habitation; Minor damage to land, crops, agricultural, commercial or industrial facilities, transportation, utilities or other public facilities or values.
- Significant Risk: No concentrated urban development, 1 or more permanent structures for human habitation which are potentially inundated with flood water at a depth of 2 ft. or less or at a velocity of 2 ft. per second or less. Significant damage to land, crops, agricultural, commercial or industrial facilities, loss of use and/or damage to transportation, utilities or other public facilities or values.
- High Risk: Urban development, or any permanent structure for human habitation which are potentially inundated with flood water at a depth of more than 2 ft. or at a velocity of more than 2 ft. per second. Major damage to land, crops, agricultural, commercial or industrial facilities, loss of use and/or damage to transportation, utilities or other public facilities or values.

High risk dams are located through the state and pose a potential risk to many of Idaho's more densely settled communities.

Ice/Debris Jam Flooding

Factors Contributing to Ice/Debris Jam Flooding

Flooding from ice jams is relatively common in Idaho. Ice jam formation depends on air temperature and physical conditions in the river channel. Ice cover on a river (a precursor to the ice jam) is formed when water reaches the freezing point and air temperature are sub-freezing; large quantities of ice are produced, flow downstream, and consolidate. After some period, this ice cover will break up and flow downstream, due to rising and warming stream flows. Initial weakening often occurs along the shore resulting in large ice masses mobilized in the channel. The transported ice may block the river's flow when an ice jam forms at obstructions such as islands, sharp bends, or more-resistant sections of down stream ice cover. Flooding occurs as the water is diverted onto the land adjacent to the river and may occur well outside of the normal floodplain. When the jam eventually washes out (weakened by rising temperatures or the

[16] Idaho Administrative Code, IDAPA 37, Title 3, Chapter 6, Section 25: Safety of Dam Rules.

force of the river) it often cuts a channel through the center of the jam, leaving large quantities of ice along both shores. This ice may remain all winter allowing successive ice jams during the same winter to form more rapidly.

Similarly, floating debris can accumulate at a natural or man-made obstruction and restrict the flow of water. Water held back by the debris jam can cause flooding upstream, inundating a large area and often depositing debris which remains after the waters have receded. Debris jams may result from landsliding, dumping, or inappropriate streamside vegetation management.

State Inventory of Past Events

Ice Jam Floods. Ice jams have played a role in a number of floods in the state. Significant ice jams have occurred on: the Teton, Portneuf, and Snake rivers in the east; the Little Lost (at Howe), Salmon, and Lehmi rivers in the central region; the Payette and Weiser rivers in the west; and the Kootenai (at Bonner's Ferry) and Clearwater (extensive overbank flooding in 1974 and 1996) rivers in the Panhandle region. The most notable of the ice jam flood was on the Lemhi River near Salmon in 1984, an event that led to a Federal Disaster declaration.

Lemhi Ice Jam Floods – 1984.[17] In January 1984, extensive ice jam formation in the Lemhi River just above the confluence with the Salmon River lead to flooding in and around the town of Salmon. Weather leading to this ice jam flood was typical, nighttime temperatures averaging -20°F and daytime temperatures near 0°F. Although initial ice jam build up began on December 22 in the Salmon River, aggressive ice control and flood fighting had allowed local crews to contain the flood waters prior to January 19. Flood damage occurred on January 19, 21, 23, and 28. After the flood waters receded, ice up to 3 feet thick remained in many homes and ice nearly 5 feet thick remained around homes and along streets. Ice jams are frequent in the area but the flooding was labeled as a base flood event.

President Reagan declared the Lemhi County ice jam, ice and flooding damages a disaster on February 16, 1984 (under the designation of DR-697). The entire county was included in the declaration. Disaster costs included approximately:

- $433,000 of public assistance – flood fight, cleanup, and repair work (including extensive levee reconstruction by the US Army Corps of Engineers).
- $613,000 of private assistance – SBA home and business loans, insurance claims, and grants.

Most of the damage was concentrated in Salmon and adjacent developed agricultural fields. Only minor injuries were reported, but 325 people were displaced and 81 residences were damaged. Much credit was given to local search and rescue teams for avoiding serious injury and loss of life. Businesses, roads, sewers, and levees were also damaged.

Debris Jams. Woody debris commonly piles up in many drainages, especially those that have been logged. Lightning Creek (Pend Oreille), Lawyer Creek, Little Wood River (Ketchum and Hailey) have all experienced flooding from debris jams. Flooding from such events tends to be localized.

Projected Occurrences

Ice jams are relatively common in Idaho. For example, a study conducted following the Lemhi River ice jam flooding in 1983, revealed that during the period of 1910-1983, ice jams reached the town of Salmon in 25 years, with jams occasionally building up to Salmon twice during a single winter. Elsewhere on the river, significant ice jams were found to have occurred in nine out of every ten winters between 1899 and 1983.

Ice jams can be expected to continue forming on rivers throughout the state. Debris jams may also be expected to continue forming and are directly influenced by human actions and other hazard occurrence (e.g., landsliding).

[17] Idaho Department of Water Resources & Idaho Bureau of Disaster Services, 1985.

Hazard Mitigation

Policy Framework

Several State-level documents specifically address flood damage policy, building on the general hazard mitigation policy framework established earlier in the Plan.

Idaho State Code

Flooding is the one hazard that the state legislature has seen fit to specifically address. The findings in Idaho State Code Title 46, Section 1020 establish the State's flood damage reduction policy guidelines:

- The public interest requires that the floodplains of Idaho be managed and regulated in order to minimize flood hazards to life, health and property.
- Local units of government have the primary responsibility for planning, adoption and enforcement of land use regulations to accomplish proper floodplain management. Furthermore, they are best able to adopt and implement comprehensive floodplain management programs that include non-regulatory techniques to accomplish the purposes of this act in cooperation with federal, state and local agencies.
- Flood damage and the number of people and structures at risk in flood hazard areas should be reduced through proper *floodplain management*[18], including such measures as floodplain zoning ordinances which require structures to be built at a *flood protection elevation*[19] and/or with *floodproofing*[20].

State Water Plan

The State Water Plan, prepared by Idaho Department of Water Resources, is the key active policy statement regarding water resources and flooding in the state. The most recent version of the plan establishes the State's policy to :

- Encourage the protection of flood plains and reliance on management rather than structural alternatives in reducing or preventing flood damages.[21]

  Flood damage can be limited by providing sufficient space in the floodplain to accommodate flood waters. Local government is encouraged to plan for floodways and protect flood plains from further development.

  Prospective buyers should be made aware of identified flood prone areas. The pressures to develop areas subject to periodic flooding will continue to increase as population increases. Buyers should realize those flood prone areas require special construction provisions to avoid flood losses.

  The NFIP should be adopted state-wide. This program requires that local units of government zone and control flood prone areas in order to be eligible for most federal assistance and prevent

[18] Idaho State Code 46-1021: "The analysis and integration of the entire range of measures that can be used to prevent, reduce or mitigate flood damage in a given location, and that can protect and preserve the natural, environmental, historical, and cultural values of the floodplain."

[19] Ibid.: "An elevation that shall correspond to the elevation of the one percent (1%) chance flood (one hundred (100) year flood) plus any increased flood elevation due to floodway encroachment, plus any required freeboard."

[20] Ibid.: "The modifications of structures, their sites, building contents and water and sanitary facilities, to keep water out or reduce the effects of water entry."

[21] Idaho Department of Water Resources, 1997; Policy 3I.

damage in the community. Floodplain maps prepared for FEMA are available through IDWR.

- Regulate the construction and maintenance of flood control levees. [22]

  The only standards applicable to the construction of flood control levees in Idaho are in the Rules governing Stream Channel Alterations. These standards apply only when all or part of the levee will be located below the mean high water mark.

  Flood control levees are maintained by local entities. There are no maintenance regulations so the degree of maintenance varies with the capability and diligence of the responsible organization. This situation creates potential hazard that levees may deteriorate to the point of being unsafe.

  All new flood control levees should be required to be built to standards promulgated by the Department of Water Resources. The Department should also be authorized to develop maintenance criteria for flood control levees and to insure compliance with these criteria through an inspection program.

  When a levee is scheduled to be rebuilt, a cost/benefit analysis should be conducted to determine if it is prudent to rebuild the levee in question or buy the property which the levee would protect.

The State Water Plan also establishes a number of environmental quality and fish and wildlife habitat policies that are relevant to flood mitigation actions:

- That the public interests be considered when decisions are made to maintain sustainable populations of plant and animal species whose existence is threatened by mankind's actions.[23]
- To cooperate, insofar as allowed by state law, in efforts to conserve and restore plant and animal species listed by the Federal government as Threatened or Endangered.[24]
- That comprehensive management plans for surface use and water quality protection be developed for lakes and reservoirs in the state.[25]
- That climate variability be considered in planning for and in the management of the state's water resources.[26]
- To have the Idaho Water Resource Board appropriate in-stream flows when it is in the public interest.[27]
- To protect the ecological viability of riparian habitat and wetlands within the state in the public interest.[28]
- That the costs and benefits of stream channel rehabilitation be evaluated where past activities currently or potentially affect the yield or quality of the state's watersheds. [29]

  Catastrophic flooding is often the outcome of heavy run-off combined with human disturbances, and may result in the destruction of stream channels. The functional loss of impacted channels may threaten public safety, private property, and the overall quality and quantity of water produced in the affected watershed. It is appropriate for the state to take action to rehabilitate impacted stream channels where public safety may be threatened, or where the remedial costs are less than the potential damages.

Other

The Flood Damage Reduction Plan (prepared in 1996 by the Bureau of Disaster Services) and the reports produced by the Interagency Hazard Mitigation Teams for the last three

[22] Ibid.; Policy 3J
[23] Ibid.; Policy 2A.
[24] Ibid.; Policy 2B.
[25] Ibid.; Policy 2C.
[26] Ibid.; Policy 2D.
[27] Ibid.; Policy 3A.
[28] Ibid.; Policy 3D.
[29] Ibid.; Policy 3E.

Federally declared flood-related Disasters (DR-1102, DR-1154, and DR-1177) articulate the State's desire to develop a comprehensive and coordinated approach to flood hazard mitigation. Additionally, the Flood Damage Reduction Plan lists four objectives:

1. Enhance coordination of agencies and consistency of flood damage reduction policy.
2. Increase knowledge of flood hazards, flood hazard mitigation approaches and the impacts of land uses, flood damage and repair, and resource management practices on watershed dynamics, fish and wildlife populations, and flood hazards.
3. Reduce vulnerability to flood damage and environmental impacts through coordination with land planning efforts, improved design and construction standards, and programs that address current at-risk development.
4. Strengthen flood preparedness, response, and education.

Finally, the DR-1154 report reinforces the State's commitment to local level implementation:

Most important in this effort is local government involvement in the examination and implementation of hazard mitigation alternatives to protect residences, businesses, and infrastructure from future damages.[30]

Policy Summary

Flooding is recognized as one of the most significant hazards in Idaho. The public interest clearly requires that flood hazards to life, health and property be minimized. The following are priorities in the effort to accomplish this:

- Manage and regulate the floodplains to include:
  1. Floodplain zoning ordinances and design and construction standards that require structures located in the floodplain be flood-resistant or flood-proofed and programs that address current at-risk development.
  2. Reliance on management (such as coordinated land planning efforts and protection of floodplain functions) rather than structural flood controls.

  3. Balancing conservation and restoration efforts and protection of ecological viability of riparian habitat and wetlands with the public interest.
- Place primary responsibility on local units of government.
- Regulate the construction and maintenance of flood control levees.
- Enhance coordination of agencies and consistency of flood damage reduction policy.
- Increase knowledge of flood hazards, flood hazard mitigation approaches and the impacts of land uses, flood damage and repair, and resource management practices on watershed dynamics, fish and wildlife populations ,and flood hazards.
- Strengthen flood preparedness, response, and education.

Existing Mitigation & Mitigation Planning Programs

Flooding is one of the most damaging and visible of the hazards that impact the state. This high priority and profile has given flooding considerable weight in mitigation and mitigation planning activities.

National Flood Insurance Program

Communities participating in the National Flood Insurance Program (NFIP) must make some effort at managing development in the floodplains that have been identified. Typically, regulations are based on flood hazard

[30] Interagency Hazard Mitigation Team, n.d.; p.5.

areas established by the Flood Insurance Rate Maps (FIRM) provided by FEMA; preparation of the FIRM allows for implementation of floodplain management ordinances in a community.

Since floodplain management is at the local jurisdictional level, implementation varies with the range of counties and cities represented. While structures constructed before publication of the FIRMs continue to be at risk, a number of them have been acquired, relocated, or elevated using funds from the Hazard Mitigation Grant Program.

Flood Mitigation Assistance Program

The Flood Mitigation Assistance (FMA) program is a key proactive mitigation planning tool for local governments in Idaho. Funding for flood mitigation programs under the program is seen by BDS as a catalyst for eventual preparation of all-hazard mitigation plans by all of the counties. The applicant community must be a participant in the National Flood Insurance Program and implement the 1994 or later Uniform Building Code. A list of Counties and their plan completion status is included in Appendix F.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) has been the key funding source for mitigation actions in the state. Building elevations, property acquisitions, and small-scale structural projects have all been completed as a result of HMGP. Appendix G contains a list of projects.

National Dam Safety Program

The National Dam Safety Program (NDSP) is administered in Idaho by IDWR. This program focuses on inspection, classification, and emergency planning for dam safety.

Other

There are a number of structural and non-structural measures in place to reduce flood caused damages. These measures are undertaken and maintained by Federal, State, and local agencies and private interests.

Thirteen Flood Control Districts exist in the state. Flood Control Districts goals include:

- Constructing or proposing projects to reduce flooding
- Protecting and maintaining present flood works
- Discouraging development in the floodplain

Structural projects for flood damage reduction in Idaho consist of reservoirs, levees, and stream channel alteration. Storage projects and levees in the state protect an estimated 250,000 acres from damage by a base flood event. Structural flood controls range from the major dams to shovel-built berms. Levees in many areas are non-engineered, the remnants of previous flood fights. Unclear regulation and ownership has led to continuing levee maintenance problems throughout state. With ownership uncertain, even some levees constructed by the US Army Corps of Engineers or the Natural Resources Conservation Service have not been maintained.

Nonstructural projects include watershed improvement and land use zoning within floodplains. Land use zoning (often related to NFIP participation) is used to prohibit inappropriate construction within floodplains, allowing local communities to prevent future flood damages. Watershed improvement projects experiment with land management methods and small water projects to reduce surface runoff and slow peak flood flows on rangeland, farmland, and forest land.

General Approaches to Mitigation

Flood mitigation is principally involved with accommodating desired social and economic use while preventing losses to life, health, and property. In general, flood damage may be mitigated by keeping humans and structures separate from floodwaters through controls on

land use, actions to increase waters storage capacity, removal or elevation of structures and controlling development in the floodplain, structural measures such as levees and dikes, and increasing the understanding of the flood hazard by the public and decision makers. Recommendations for steps to implement each of these approaches are presented in the five categories:

- Hazard Management
- Information/Education
- Infrastructure
- Regulatory
- Mapping and Analysis

A key distinction of flooding when compared to other hazards is the extent to which the actions of others can influence flooding impact on a community. Activities in the upper portions of the basin that generate additional surface water runoff, in-stream debris, or sedimentation may increase flood impacts on downstream communities. It is essential that flood mitigation planning address the entire basin and that communities undertaking local planning efforts coordinate and cooperate with adjacent jurisdictions.

In comparison to riverine flooding, flash flooding comes with little warning and is considerably less predictable. Flash floods are generally triggered by more concentrated events (e.g., focused thunderstorms, overwhelmed infrastructure, and dam failures) that are harder to foresee with any reliability. Certain areas though, due to terrain and precipitation regimes, can be seen as relatively high-risk. Mitigation focuses on controlling the factors that can be controlled and providing for effective evacuation, response, and recovery.

Mitigation for ice and debris jam floods is closely related to riverine and flash flooding mitigation and is not described separately. The obvious additional step is to control the jam-forming material prior to the event.

Hazard Management

Flood hazard management maybe accomplished through structural (e.g., levees and dikes) and non-structural (e.g., constructed or enhanced wetlands) means. These means involve manipulation of existing or constructed of new features to compensate for changes that have occurred in the floodplain. Such changes may be the result of development or other land use practices, that either has increased the likelihood or extent of flooding or that has placed residents or businesses within the floodplain.

As with riverine flooding, flash flood hazard management may be accomplished through structural (e.g., retention ponds and dams) and non-structural (e.g., revegetation following wildland fire and stream channel maintenance) means. Although the flash flood may result from any of several causes, in general hazard management is the same:

- Avoid sudden releases of large quantities of water (e.g., improve the watershed's ability to retain precipitation or strengthen and maintain dams).
- Keep the water that can not be stopped separate from people and property (e.g., build sufficient storm water facilities, maintain an adequate warning and evacuation system).
- Direct site development away from the apex of alluvial fans and dam failure inundation zones.

Information/Education

As described above, continued flood damages have been associated with a misunderstanding of the extent of flood hazard areas and/or the potential impacts of flood waters. Public information and education is the first line of defense, not only increasing the knowledge of the problem but also gaining higher compliance with regulatory and voluntary mitigation measures.

In areas that have not seen recent flash flooding, the hazard may be seriously undervalued due to a lack of obvious remainders (such as

large river channels). Many residents and property owners may be unaware that their lives and properties lie in high-risk areas. Residents and property owners should be informed of known flash flood inundation zones. When they are aware, residents and property owners can play an important role in mitigation.

Infrastructure

Flood-resistant infrastructure can be built but is often comes at a premium. Roads and other transportation infrastructure are often hard hit by flash floods. In much of the state, the mountainous terrain strongly favors construction of roads and other lifelines through the relatively accessible (and inexpensive) narrow valleys that may be prone to flash floods. Infrastructure that can not be relocated from high-risk areas must be "flash flood-proofed" or contingencies must be developed to maintain the systems function.

Regulatory

With the exception of key flood mitigation elements, such as levee construction, the State has clearly stated the policy that direct legal controls through regulation occur at the local level. Consequently, the State's legislative involvement is confined principally to incentives and assistance. One key regulatory step that can be taken at the state-level is mandating full disclosure of flood hazards during real estate transactions.

One of the few effective steps for dam failure-caused floods is careful land use planning that keeps development out of inundation zones. Local governments need to identify and provide for appropriate use of at-risk areas.

Mapping & Analysis

Accurate mapping of flood-prone areas is the first step in mitigation. This analysis depends on knowledge of the normal hydrologic regime and past flood events through direct observation and inference from other environmental data. Developing a comprehensive database is a key priority of the overall flood mitigation effort.

Recommended State-wide Hazard Mitigation Actions

Hazard Management

SHMP-HM01	Develop and Implement Methods for the Identification and Disposal of Non-hazardous Waste Transported by Flooding
SHMP-HM02	Address Heavy Metal Contamination Problems through Identification, Containment, and Cleanup
SHMP-HM03	Clear and Maintain Stream Channels
SHMP-HM04	Control Upstream Sediment and Debris Sources
SHMP-HM05	Stabilize Disturbed Reaches to Control Sediment
SHMP-HM06	Develop a State-wide Levee Safety Program and Levee Task Force
SHMP-HM07	Establish a Flood Hazard Advisory Commission

SHMP-HM08	Develop and Implement Techniques for Ice Removal
SHMP-HM09	Improve Dam Safety

Information/Education

SHMP-IE01	Increase Public Awareness of Flood Hazards and Mitigation Possibilities
SHMP-IE02	Establish a Flood Awareness Week in Idaho
SHMP-IE03	Develop and Publish a Flood Information WWW Site
SHMP-IE04	Develop and Distribute a Floodplain Conservation Toolkit
SHMP-IE05	Encourage the Use of NOAA Weather Alert Radios in Flash Flood High-risk Areas

Infrastructure

SHMP-IS01	Improve Bridge Safety

Regulatory

SHMP-RE01	Adopt State-wide Floodplain Management Legislation
SHMP-RE02	Revise the State Executive Order on Floodplain Management
SHMP-RE03	Update Highway Design Standards

Mapping & Analysis

SHMP-MA01	Improve Collection of Long-term and Real-time Hydrologic Data
SHMP-MA02	Develop and Maintain a Floodplain Hazardous Materials Inventory

URBAN/WILDLAND INTERFACE FIRES

Hazard Assessment

Fundamentals

Wildland Fires

Wildland fires are a cause of great fear in rural and urban/wildland interface areas of Idaho. Fire can quickly consume large areas, destroying property and taking lives. When huge fires, or conflagrations, strike, there is often little that can be done to control them, and residents may be forced to flee. Dense smoke may fill the area for miles around the fire impacting areas not directly affected by the flames. Because smoke from such fires contains substantial amounts of fine particulate matter and other hazardous pollutants, fires pose direct health impacts, especially for the young and elderly, as well as economic damages due to loss of tourist business. Wildland fires also threaten infrastructure (e.g., leading to increased sedimentation impacting reservoirs) as well as wildland resource values such as water, timber, wildlife habitat, and recreation.

Wildland fires may spawn secondary hazards, such as flash flooding and landsliding, long after they have been extinguished. Vegetation provides a number of physical functions which contribute to the hydrologic and slope stability regimes of an area. When this vegetation is consumed in wildland fire, resulting changes may include decreased rainfall interception and infiltration; faster concentration times and greater volume of peak flows; increased volume and velocity of overland runoff; and loss of reinforcing roots. The intense temperatures of wildland fire may also cause chemical changes in the soil, resulting in hydrologic changes similar to those described above. These areas may not return to pre-fire conditions for decades.

Wildland fires result from the interaction of the elements of the "Fire Triangle": fuel, flame (ignition), and oxygen. All three of these are necessary for fires to ignite and sustain themselves. Weather and climate influence these elements and consequently influences wildland fire origin and behavior.

Fuel in a wildland setting is typically vegetation. The nature of that vegetation, its continuity, volume, and type, controls the fire. The continuity of the fuel controls the fire spread; patchy vegetative patterns and created fire breaks (intentionally denuded areas) slow the fires progress. The amount of available vegetative fuel is referred to as the "fuel load." Increases in the fuel load result in increases in the potential energy release (i.e., the severity of the fire).

Wildland fires can be classified by the fuel that they consume – as understory fires, crown fires, and ground fires. In many cases, wildland fires under natural conditions burn at relatively low intensities, consuming grasses and other herbaceous plants, woody shrubs, and dead trees. Such "understory fires" are natural occurrences in many environments and often play an important role in plant reproduction and wildlife habitat renewal. Left to themselves, these fires will burn themselves out when the fuel load is depleted or they are doused by rain or snow. "Crown fires," where whole living tress are consumed, are less frequent but considerably more destructive. These are typically what is pictured when people think of large, disastrous fires. In areas with high concentrations of organic materials in the soil, "ground fires" may burn in this material, sometimes persisting for long periods out of sight until a surface fire is ignited. As is often the case with natural phenomenon, most fires will exhibit some combination of these characteristics rather than falling neatly into a category.

The primary natural ignition source is lightning; human sources include fireworks, power lines, campfires and debris burning, motor vehicles, machinery (e.g., chain saws and lawnmowers), and arson. More than four out of every five forest fires are started by people. Arson is a major cause of wildland fires; for example, Ada County reports that arson is responsible for over half of the wildland fires within its jurisdiction.

Oxygen is rarely a limiting factor in wildfires but a fire's dependence on it does control its behavior, leading to a generally wind-driven

and upslope pattern. Slope is a key topographic feature in fire behavior; the rate of fire spread can increase with increases in the pitch of the slope. Gulches and canyons can funnel air and act as chimneys, which intensify fire behavior and cause the fire to spread faster. Similarly, saddle-shaped lands on ridge-tops lower resistance to the passage of air and draw fires.

Weather is the most variable factor affecting wildland fire behavior. Strong winds can propel the fire quickly across the landscape. Although pre-dominant wind directions may guide a fire's path, gusty, shifting winds can lead to "erratic" fire behavior that makes fire management and control tasks much more dangerous. Solar heating of drier, south-facing slopes produces upslope drafts that can complicate fire behavior. Large fires can further complicate the picture by creating their own weather as strong updraft created by intense heat overwhelms the "natural" winds caused by atmospheric factors and terrain.

Some geographic locations have a favorable overall climate for wildland fire activity. High-risk areas in Idaho typically have a hot, dry season in summer and early fall when high temperatures and low humidity favor fire activity. Such conditions increase the combustibility of fuels and are often accompanied by strong, gusty winds and thunderstorm activity. It is often a change in weather (e.g., decrease in winds or increase in humidity) that marks the end of a wildfire's growth.

Urban/Wildland Interface

Many areas in Idaho and throughout the West have seen recent population growth in what is referred to as the "urban/wildland interface." This is where urban development and structures occur adjacent to a primarily undeveloped landscape, an area where potentially dangerous fuel loads are found adjacent to combustible homes and other structures. The urban/wildland interface may be distinguished from rural development by the "wild" or "unmanaged" quality of the landscape and the fire danger posed by that landscape. In recent years, growing numbers of formerly urban residents have been drawn to interface areas by scenic beauty, inexpensive land, and a perception of relief from urban stress.

Wildland fire fighters further divide this zone into two sub-zones:[31]

- Urban/Wildland Interface: The first wave of structures adjacent to dense wildland vegetation.
- Urban/Wildland Intermix: An area where individual homes or pockets of structures are completely surrounded by wildland fuels.

These two sub-zones will be referred to collectively as the urban/wildland interface (UWI) here.

Urban/Wildland Interface Fires

The urban/wildland interface fires are those wildland fires which burn within the urban/wildland interface (either originating there or spreading from the wildlands). These fires are of particular interest due to their threat to human health, safety, property and infrastructure. Development in these areas not only places structures in the path of existing fire patterns, it also adds numerous potential sources of ignition and complicates the fire control mission.

In urban settings, firefighters generally deal with structural fires which are fought directly with water readily available from fire mains and hydrants. Rapid response is a key element in extinguishing fire while it is still manageable. In wildland settings, fire fighters use more indirect techniques to contain the fire within a perimeter and deprive it of fuel. Multiple fire fighting organizations or agencies may be involved, requiring a high level of communication and coordination of resources.

Urban/wildland fires pose a mix of conditions that are not wholly suited for either wildland or urban fire control techniques. Wildland techniques, which require the sacrifice of some areas for strategic gain, are not suited to preserving structures scattered throughout the

[31] National Fire Protection Association, 1991.

fire zone. Although structures are often involved, urban-level water and staff resources are rarely available, especially when multiple structures are threatened. Even if sufficient resources are present, rapid response is often compromised by the distances and qualities of roads available in the area. Fire managers may find themselves with difficult choices between saving structures or large undeveloped areas and their natural resources.

When limited resources are challenged by high-intensity fire storms, they are easily overwhelmed, resulting in evacuations and loss of property. Unfortunately, large fuel loads are often associated with the fringes of the urban areas due to historical suppression efforts. These conditions set the stage for high-intensity urban/wildland interface fires.

Communities in the urban/wildland interface tend to have limited infrastructure (e.g., access roads and water services) and staffing resources due to small tax bases. These areas, especially those undergoing rapid growth, tend to be under-served by local fire protection. Many rural areas have inadequate personnel and equipment, and some have no fire protection at all. Such communities, which have constrained financial resources, may also have a more difficult time recovering from fire disasters.

The urban/wildland fire situation is often complicated by residents who are unfamiliar with the level of fire protection available. They assume that the urban standards with which they are familiar apply and fail to take adequate precautions. Residents often prefer homes that are private, have scenic views, are nestled in vegetation, and use natural materials (e.g., wood shake roofing, an excellent fire propagator). A private setting may be a location far from public roads, or at least hidden behind a narrow, curving driveway. These conditions make evacuation and fire control difficult. The scenic views found along mountain ridges and valley slopes can also mean areas of dangerous topography. Natural vegetation contributes to scenic beauty, but it may also provide a ready trail of fuel leading a fire directly to the combustible fuels of the home itself.

Wildland fire can threaten buildings, or, conversely, a burning structure can introduce fire into wildlands with the potential of destroying valuable natural resources such as timberlands, habitat and watersheds as well as other homes. When a wildland fire enters an urban/wildland interface area, the cost to wildland resource values may increase. As the control situation shifts to structural protection, undeveloped areas may have to be ignored; the end result is an increase is response costs and a reduction in wildland acreage protected.

Fires in the urban/wildland interface often occur in a very complex jurisdictional landscape. A variety of Federal, State, and local agencies have authority and responsibility for fire preparedness, response, recovery, and mitigation. The response and control situation is complicated by a lack of uniformity of priorities, training, equipment, and experience among the agencies. In particular, urban/wildland interface communities adjacent to Federally-owned land managed for wilderness values (where fires are not aggressively controlled) must engage in a high level of coordination of fire prevention, response, recovery, and mitigation efforts.

State Inventory of Past Events

The urban/wildland interface is a relatively new concept, both in terms of actual occupation of the zone and tracking of fire incidents. A lack of designation of fire location characteristics in official records makes a substantive analysis of past events difficult. Federal and State wildland fire fighting agencies generally only note the number of fires and the acreage. The State Fire Marshall records the number of calls to certain types of fires (including outdoor fires) but does not note if the call is related to wildland fires or the significance of the response.

Some illustrations of the wildland fire danger are possible. According to the Bureau of Land Management, there was an annual average of

297 fires over 205,433 acres between 1988-1997.

Table 12 presents an account of some of the significant wildland fires that have been recorded in Idaho. While specific references to urban/wildland interface type losses are limited in this table, the scale and frequency of Idaho wildland fires are well illustrated.

During the period 1976 to 2000, twelve wildland fire events (or groups of events) resulted in State-declared Disasters. Nine of these disasters covered the entire state. One of these events, the fires of the summer 2000, was also Federally-declared and is described below. Throughout the West, the number of large wildfires, and of acres burned by them, has increased over the last decade, as have the costs of attempting to put them out.

Summer 2000 Wildland Fires

As of September 26, 2000 the National Interagency Fire Center reported that 1,541 fires had burned 1,235,150 acres in the state during the fire season that some called the most serious wildland fire season in U.S. history. As a result of an adverse weather pattern ("La Nina"), a combination of hot temperatures, low relative humidity, little or no precipitation and plenty of wind led to numerous fires ranging from small to massive complexes.

Unlike in many past wildland fire seasons whose impacts were confined to wildlands and Idaho's relatively isolated, small communities, large towns such as Salmon were threatened and affected.

Thirteen fires led to evacuations; sites evacuated included two small towns, three mining areas, and many scattered residences. There were only seven serious injuries in Idaho, a significant success considering the number of residents who were evacuated and assisted in initial attacks by creating fire lines around their properties or fighting the fires, and the number of personnel on the fire lines.

Table 12 - Significant Idaho Wildland and Urban/Wildland Interface Fires			
Year	**Disaster Declarations (1976-2000)**	**UWI Impact**	**Comments**
1910	-	X	Eighty-five lives lost; fire consumes 1/6 of north Idaho forests, destroying many communities.
1960	-	?	Large fires burn in Hells Canyon and Idaho City areas.
1967	-	?	Ten counties in Panhandle affected; 50,000 acres burned in nine hours.
1985	State (2)	?	Two state-wide declarations (July and August).
1986	State	?	State-wide declaration.
1987	State (4)	?	Three counties declared individually: Ada (June), Adams (August), and Bannock (August); state-wide declaration in August.
1989	State	X	The worst fires since 1910 burn thousands of acres in south central Idaho, partially destroying the town of Lowman and leading to state-wide declaration.
1992	State (2)	X	One life lost in the worst fire season in Idaho history to date; one of two state-wide declarations was for an unusual spring event (April).
1994	State	X	One life lost and one home lost; summer wildfires burn a total of over 750,000 acres resulting in a state-wide declaration.
2000	State, Federal	X	More than 1500 individual fires.

Sources: National Interagency Fire Center, n.d.; Idaho Department of Lands-Bureau of Fire Management, 2000; Idaho Department of Insurance-State Fire Marshall, 2000; USDA Forest Service-Northern Region and Intermountain Region, 2000.

Smoke from the fires became a constant companion to residents throughout the state, affecting the health, recreation and daily life of many communities. Several times the Idaho Department of Environmental Quality issued air quality advisories to several communities in Idaho because of "very unhealthy" or "hazardous" air quality concerns. The town of Salmon requested and received air purification cleaners for their residents.

Recorded losses include 700 cattle lost on one ranch in Dietrich, Idaho. There were 109 structures destroyed: thirty-eight residences (homes, cabins or trailers), seventy outbuildings, and one commercial building/business. A total of 9,568 structures were threatened: 6,061 primary residences, 1, 635 outbuildings, and 1,872 commercial building/businesses. The town of Atlanta required importation of potable water due to damage to the town's water system.

Emergency closures of Federal and State lands affected approximately 3 million acres. Over 2,000 miles of trails, over 80 miles of river and almost all public airstrips were closed. Restrictions were placed on the use of campfires, smoking, use of chainsaws and other equipment.

These closures and restrictions had an enormous impact. Many businesses that depend on the region's tourism in the summer and fall

seasons suffered economically. During the twenty-six days that the Salmon River in the Frank Church River of No Return Wilderness was closed to recreation, 4,000 outfitter floaters, 2300 private floaters and 140 commercial jet boaters who were scheduled to float the river were unable to take their trips. These lost trips resulted in a loss of personal income and employment for surrounding communities. The closures also affected the plans of about 600 hunters who had booked guided hunts in the wilderness area, in addition to the large number of resident hunters depending upon big game for their winter food supply.

During the height of the land closures 150 businesses were unable to operate, resulting in losses of approximately 2.5 to 3 million dollars in the retail trade and transportation business sectors. Mining and logging industries were also been affected.

The Governor declared an emergency for the entire state on July 27, 2000. The President declared a Federal Disaster on September 1, 2000. Fifteen counties and one reservation were made eligible for Individual Assistance funding and the entire state was made eligible for Hazard Mitigation funds.

Projected Occurrences

Wildland Fires

Wildland fire danger in the West became a topic of national interest in the 1990s. Throughout the second half of the 20th century, tree stands on national forests of the interior West grew much denser, underwent shifts in species composition, and experienced increases in some insect and disease infestations. These conditions increased the threat of catastrophic wildfires.

After declining fairly steadily for most of the century, the average number of acres burned by wildfires annually on national forests began to rise during the 1990s, nearly quadrupling to about three-quarters of a million acres per year. Virtually all of this rise is attributable to the increasing number of very large fires resulting from past suppression efforts. These past management practices, especially the Forest Service's decades-old policy of putting out wildfires on the national forests, disrupted the historical occurrence of frequent low-intensity fires, which had periodically removed flammable undergrowth without significantly damaging larger trees.

The situation in Idaho and the West in general has been summarized as:

> "Because this normal cycle of fire was disrupted, vegetation has accumulated, creating high levels of fuels for catastrophic wildfires and transforming much of the region into a tinderbox."[32]

The majority of the Idaho's forested lands are vegetated with species that naturally experience a 35-100 year fire cycle; much of the range land should experience a 0-35 year frequency. These high frequency/low severity fire regimes have experienced the most evident changes due to inappropriate land and fire management. In dry forest areas, frequent fires naturally maintained an open understory and relatively few, but large, mature trees. Today, due to fire suppression, many of these areas are much thicker forests dominated by more shade tolerant, and less fire resistant tree species.

Negative changes have also occurred in cooler, moister forests where infrequent fires consume older trees but spare the younger, more fire-resistant ones. What was previously a patchwork of age classes has been replaced by uniform forests that present large, continuous fuel loads. As a result, fires may burn more intensely and over larger areas than they would have if the natural fire regime had not been suppressed.

In Idaho, much of the Panhandle and Southwestern regions have developed fire regimes significantly altered from their historical range. Without significant landscape and management changes, major fires can be expected to occur in a frequency similar to that which occurred during the 1990s. Furthermore, the

[32] General Accounting Office, 1999.

"window of opportunity" for taking management action throughout the West is only about 10 to 25 years before catastrophic wildfires become widespread. Even with aggressive land management, it is expected that it will take decades to return the altered forests to their historic fire regime.

Urban/Wildland Interface Fires

The extent to which projected wildland fires impact the property and lives of Idaho's residents is a function of the vulnerability of homes, businesses, infrastructure, and public facilities to those fires. As development has occurred in the urban/wildland interface, the losses associated with wildland fires have increased. This trend is expected to continue.

Urban/wildland interface fire losses can be expected both in smaller mountain communities and on the fringes of the larger, more urban communities throughout Idaho. Communities located within or adjacent to forests identified as high-risk (such as the significantly altered forests discussed above) should also be considered high-risk.

Regional analysis can suggest that fires are more likely, but projections for specific areas will require up-to-date local analysis. All interface communities face significant risks when local conditions are favorable for fire formation. Ambient risk for an individual community may be evaluated based on terrain and fuel load conditions, development patterns and land use (at-risk structures and landscaping and possible ignition sources), land management practices, and seasonal and daily weather.

Hazard Mitigation

This section of the Plan focuses on mitigation of wildland fires that impact communities in the urban/wildland interface (where the primary risk to Idaho resident's lives and property occurs). State management of wildland fires burning in remote areas with no or only a very limited number of structures and residents fall under the jurisdiction of the Idaho Department of Lands.

In general, mitigation of wildland fire risk is associated with the use and management of the wildlands. Therefore, State, Federal, and private land managers play a large role in mitigation through their ongoing management practices. Urban/wildland interface fire mitigation requires a broader approach to mitigation, one that considers the role of the nature and location of human development.

Policy Framework

Wildland fire prevention and control responsibilities and authorities in Idaho are designated by Idaho State Code Title 38 (Forestry, Forest Products, and Stumpage Districts), Chapter 1 (Idaho Forestry Act) and Chapter 4 (Fire Hazard Reduction Programs). Administrative rules are included in IDAPA 20.04.01 (Rules Pertaining to Forest Fire Protection). Additional fire prevention and control responsibilities and authorities are designated by Idaho State Code Title 41 (Insurance), Chapter 2, (The Department of Insurance), specifically Sections 41-254 (Powers and Duties of State Fire Marshall) and 41-255 (Duties of State Fire Marshall).

The focus of Idaho's wildland fire policy is on prevention and control, not mitigation. Mitigation of wildland and urban/wildland interface fires is established, generally, in the Idaho Disaster Preparedness Act of 1975 as amended (Idaho State Code Chapter 10, Title 46) and, more specifically, in the Governor's Executive Order, 2000-04. The Executive Order assigns primary responsibility to Idaho Department of Lands to cooperate with federal, state, and local governments in developing plans for and directing activities relating to

the prevention and control of wildland and urban/wildland interface fires.[33]

Mitigation and Mitigation Planning Programs

State Government

Idaho's wildland and urban/wildland interface fire focus is on prevention and control; mitigation activities are limited.

Idaho Department of Lands. Idaho Department of Lands (IDL) is the principal State agency with wildland and urban/wildland interface fire prevention, control, and mitigation responsibilities. IDL manages the state endowment lands which comprise nearly 2.5 million acres.

The Bureau of Fire Management within IDL is responsible for fire management on these endowment lands and an additional 3.5 million acres of private, state, and federal forest lands. The Bureau also assists local communities with urban/wildland interface fire issues. IDL Fire Wardens, located throughout the state, are the point of contact with fire service organizations.

IDL also administers the Communities at Risk program in Idaho. "Communities at Risk" is a Federally-funded response to the disastrous fires of 2000, designed to reduce the risk to urban/wildland interface communities. Initial mitigation under this program include thinning, fire break construction, and homeowner education. The program is addressing the interface in both small, isolated communities and the fringes of large urban areas.

State Fire Marshal. The function of the State Fire Marshal is fire prevention, and the office deals primarily with the urban side of the urban/wildland interface. Responsibilities and authority include regulation of buildings, control of flammable substances and products, and training and education in fire protection methods and responsibilities. The State Fire Marshal also tracks fire data in the state (the Idaho Fire Incident Reporting System) and performs investigations when warranted.

Federal Government

Federal land management agencies, with oversight of nearly two-thirds of the state, play a major role in Idaho wildland fire management. The principal Federal land management agencies, Bureau of Land Management and USDA Forest Service, work with each other and the State in wildland fire prevention, control, and mitigation. Additionally, several local fire management agencies have working agreements with the federal government.

As wildland management agencies, the mitigation efforts of the USDA Forest Service and Bureau of Land Management Federal have historically focused primarily on reduction of the wildland fire risk (rather than specific urban/wildland interface issues). This has been accomplished through harvest, pre-harvest thinning, and prescribed burning in targeted areas.

The condition of the forests of the West, along with the disastrous fires of 2000, have resulted in considerable Federal funding of wildland and urban/wildland interface fire mitigation efforts (under the umbrella of the National Fire Plan). Mitigation will be primarily through fuel reduction projects including thinning and prescribed burning on Federal, State, and private lands. Rehabilitation and homeowner education projects will also be included.

Local

Local fire prevention, control, and mitigation fall under a variety of jurisdictions including City Fire Departments, Fire Protection Districts, and Special Fire Departments (e.g., airport fire departments). Local fire management agencies are typically oriented towards urban or structural fire situations. Mitigation activities may include homeowner education and assisting with defensible space clearance. County and city governments may also engage in mitigation through land use regulation,

[33] Governor's Executive Order, 2000-04.

burning restrictions, and educational programs. Private landowners and associations can also play a key role in mitigation through land management and member education.

An excellent example of inter-jurisdictional cooperation, the Greater Kootenai County Fire Prevention Co-op is dedicated to promoting fire prevention and life safety by building public knowledge and awareness and by encouraging and coordinating the sharing of resources among local agencies. The Co-op is made up of individuals from city, county and wildland fire agencies within Kootenai County. This partnership pools the resources and talents of its members to accomplish prevention and educational activities county-wide that in many cases would not be possible due to funding and manpower. The Co-op programs and projects are funded by donations and dues paid by individual agencies.

The advantages of regional fire cooperatives include: the improved delivery of services to communities; the use of central communication centers; the assessment and prioritization of regional needs.

General Approaches

Wildland fire experts generally agree that increased fire suppression efforts alone will not be successful in stopping the large, intense wildfires likely to occur in the next several decades. Such conflagrations as occurred in summer 2000,are generally impossible for firefighters to stop and are only extinguished by rainfall or depletion of the fuel load.

Fires play a significant role in the natural cycle of the land in and around Idaho. They threaten properties and life throughout the state. But while fires cause destruction, they also provide benefits to ecosystems of the forest and range. Just as limited flooding can replenish the soils of the floodplain, appropriate wildland fires rejuvenate the forest and range by controlling disease and insect infestations and clearing open spaces for healthy growth of new vegetation.

It is therefore clear that elimination of all wildland fires is not the goal of urban/wildland interface fire mitigation. As a practical matter, and as discussed above, immediate suppression of all wildland fires has been shown to not be an effective long-term strategy. The goal is to rather eliminate or reduce the risks associated with these fires to human lives and property and desired resource values.

Specifically in this Plan, the goal is to eliminate or reduce those risks in the urban/wildland interface. Mitigation of urban/wildland interface fires generally takes the form of creating fire-resistant landscapes and development, and eliminating possible ignition sources.

Fires are remarkable in that much potential for additional damage exists after the event itself. Secondary effects include landsliding and flooding resulting from post-fire storms. Mitigation of these secondary damages will typically occur after the fire but prior to secondary hazard events.

Hazard Management

As with floods and landslides, an understanding of the factors which control fire ignition and behavior forms the basis for fire prediction, avoidance, and mitigation. Fire hazard mitigation may involve fireproofing, control of ignition, and facilitation of response. Successful prevention of fires depends on the control and elimination of one or more of the elements of the “Fire Triangle.” Before a fire begins, the fuel load can be managed through either controlled, intentionally set fires (prescribed burns), or manual or mechanical harvesting. Breaks in continuity of the vegetative cover (fire breaks) can be constructed. Fire-resistant landscaping and structures can extend the reduction of the fuel load into the “urban” side of the interface. Control of ignition sources can also be effective prevention through restriction of hazardous activities during high risk periods and effective control of structural fires.

Mitigation of secondary hazards associated with urban/wildland interface fires can be un-

dertaken separately or integrated into forest and rangeland rehabilitation efforts. In many cases, this work will require quick action (a matter of a few months) in between the fire season (summer and early fall) and the likely period for secondary events (late fall and winter). This expediency can be enabled through the establishment of organizational and physical infrastructure to allow rapid response.

Information/Education

Many urban/wildland interface residents are unfamiliar with the fire hazard associated with their homes. Relatively small steps in home design, maintenance, and landscaping can play a large role in hazard reduction. As with all natural hazards, public information and education is the first line of defense, not only increasing the knowledge of the problem but also gaining higher compliance with regulatory and voluntary mitigation measures.

Infrastructure

Infrastructure mitigation actions are primarily concerned with ensuring that the infrastructure elements can withstand or recover from the secondary hazards associated with urban/wildland fires. Where infrastructure elements (e.g., communication systems) and public facilities are at direct risk from fires, steps should be taken to fire-proof or provide for functional backups.

Regulatory

Due to the large areas and multiple land managers potentially involved, mitigation of wildland fires requires a high degree of interagency cooperation and communication between federal, state, and local agencies. Effective mitigation also requires involvement of large and small private landowners.

Mapping & Analysis

Urban/wildland interface fire hazard mapping is a dynamic activity. A comprehensive database of ambient conditions can be generated in advance of a fire season to minimize the data collection needs during fire events. An understanding of the hazard is a key in making mitigation decisions and resource allocations. Following an event, secondary hazards should be identified and mapped quickly and accurately.

Recommended State-wide Hazard Mitigation Actions

Hazard Management

SHMP-HM10	Assist with the Development of Fire-Resistant Communities
SHMP-HM11	Reduce UWI Fuel Loads
SHMP-HM12	Develop Water Supply Capacity in the UWI
SHMP-HM21	Support the formation of cooperative regional fire/emergency service groups.

Information/Education

SHMP-IE06	Develop a State of Idaho UWI Fire Public Education/Outreach Program
SHMP-IE07	Provide UWI Fire Training Opportunities for Public Officials and Representatives

Infrastructure

SHMP-IS02	Enhance Road Drainage Systems

Regulatory

SHMP-RE04	Adopt State-wide UWI Fire Hazard Reduction Legislation

Mapping & Analysis

SHMP-MA03	Identifying UWI Fire Risk by Area and Identify Non-protected Areas
SHMP-MA04	Develop UWI Fire Hazard Rating Scale

EARTHQUAKES

Hazard Assessment

Fundamentals

Although rarely in the news, earthquakes are a fact of life in Idaho. Scientific studies and the historical record demonstrate that damaging seismic events are possible throughout the state and the region. Earthquakes are one of the least predictable and poorly understood hazards.

Despite the infrequency of these events, large events that strike heavily populated areas can result in some of the most catastrophic disasters. Idaho experienced two of the largest earthquakes in the contiguous United States in the second half of the twentieth century —the Hebgen Lake earthquake (1959) and the Borah Peak earthquake (1983). Both tremors caused fatalities and millions of dollars in damage.

Causes of Earthquakes

Idaho's earthquakes result from three causes:

- Plate Tectonics
- Crustal Stretching
- Hotspot/Volcanic Activity

The surface of the earth (the "crust") is made up of large masses, referred to as tectonic plates. Many of the world's earthquakes result from forces along the margins of these tectonic plates. The tectonic plates are constantly in motion relative to each other, either pulling apart or pushing together. Pressure builds up at the contacts between these tectonic plates. Earthquakes (seismic activity) occur when this pressure is released in a sudden burst of motion. Tectonic earthquakes that occur along the west coast may be felt in Idaho.

Most earthquakes in Idaho have origins (the "epicenter") far from plate boundaries, however. Much of the earth's crust in Idaho has undergone tremendous stretching, resulting in the relative up- and down-shifting of parallel, linear ridges and valleys. Central Idaho's high mountain ranges are striking evidence of these powerful earth movements over millions of years. Earthquakes from the crustal movements in the adjoining states of Montana, Utah, and Nevada can also cause severe ground shaking in Idaho.

Finally, Idaho earthquakes may be associated with volcanic activity. Volcanic activity in and adjacent to the state is associated with the "Yellowstone Hotspot." The hotspot is a conduit carrying molten rock from deep within the earth into the crust. Pressures within the hotspot zone lead to surface failures and releases of energy. Although there are currently no surface releases of lava through volcanoes or volcanic vents, the hotspot is very seismically active. Dozens of small earthquakes are recorded in the Yellowstone region each month.

Earthquake Mechanics

Regardless of the source of the earthquake, the associated energy travels in waves radiating outward from the point of release. When these waves travel along the surface, the ground shakes and rolls, fractures form, and water waves may be generated. Earthquakes generally last a matter of seconds but the waves may travel for long distances and cause damage well after the initial shaking at the point of origin has subsided.

Breaks in the crust associated with seismic activity are known as "faults" and are classified as either active or inactive. Faults may be expressed on the surface by sharp cliffs or

scarps or may be buried below surface deposits.

"Foreshocks," minor releases of pressure or slippage, may occur months or minutes before the actual onset of the earthquake. "Aftershocks," which range from minor to major, may occur for months after the main earthquake. In some cases, strong aftershocks may cause significant additional damage, especially if the initial earthquake impacted emergency management and response functions or weakened structures.

Classification

Earthquakes are measured in two ways:

- Magnitude – measures energy released.
- Modified Mercalli Intensity Scale – measures physical effects.

Magnitude is calculated by seismologists from seismograph readings and is most useful to scientists comparing the power of earthquakes.

An earthquake of Magnitude 2.5 or less is usually not felt. Dishes rattling and china shaking occur at Magnitude 3.0 and Magnitudes greater than 6.5 are devastating events when the earthquake strikes in or near a populated area.

The Modified Mercalli Intensity Scale is a subjective description of the physical effects of the shaking based on observation at the event site. The damage from earthquake shaking is due to several factors like distance from the epicenter and local geology and soils. On the Modified Mercalli Intensity Scale, a value of I is the least intense motion and XII is the greatest ground shaking. Unlike magnitude, intensity can vary from place to place and is evaluated from people's reactions to events and the visible damage to man-made structures.

Earthquakes of intensity III may be felt, IV are generally felt, and V are definitely felt. Damage begins at intensity V and starts to become significant at VII for poorly constructed structures. Intensity VII is used as a threshold for "significant" events. Damage is widespread at intensity X and "total" at XII. The entire Modified Mercalli Scale is included in Appendix L.

Factors Contributing to Damage

The damage associated with each earthquake is subject to several variables:

- The nature of the seismic activity.
- The composition of the underlying geology and soils.
- The level and quality of development of the area struck by the earthquake.
- The time of day.

Seismic Activity. The properties of earthquakes vary greatly from event to event. Some seismic activity is localized (a small point of energy release), while other activity is widespread (e.g., a major fault letting loose all at once). Earthquakes can be very brief (only a few seconds) or last for a minute or more. The depth of release and type of seismic waves generated also play roles in the nature and location of damage; shallow quakes will hit the area close to the epicenter harder, but tend to felt across a smaller region than deep earthquakes.

Geology and Soils. The surface geology and soils of an area influence the propagation (conduction) of seismic waves and how strongly the energy is felt. Generally, stable areas (e.g., solid bedrock) experience less destructive shaking than unstable areas (e.g., fill soils). The siting of a community or even individual buildings plays a strong role in the nature and extent of damage from an event.

Development. A small earthquake in the center of a major city can have far greater consequences than a major event in a thinly populated place. The two major Idaho earthquakes, Hebgen Lake (1959) and Borah Peak (1983) were very strong but occurred in isolated areas with small populations. Damage, compared to other earthquakes of similar magnitude in heavily populated areas, was relatively light.

Time of Day. The time of day of an event controls the distribution of the population of an

affected area. On work days, the majority of the community will transition between work or school, home, and the commute between the two. The relative seismic vulnerability of each location can strongly influence the loss of life and injury resulting from an event.

Types of Damage

While damage can occur by movement at the fault, most damage from earthquake events is the result of shaking. Shaking also produces a number of phenomena that can generate additional damage:

- Ground displacement
- Landslides and avalanches
- Liquefaction and subsidence
- Seiches

Shaking. In minor events, objects fall from shelves and dishes are rattled. In major events, large structures may be torn apart by the forces of the seismic waves. Structural damage is generally limited to older structures that are poorly maintained, constructed, or designed in all but the largest quakes. Unreinforced masonry buildings and wood frame homes not anchored to their foundations are typical victims.

Loose or poorly secured objects also pose a significant hazard when they are loosened or dropped by shaking. These "non-structural falling hazard" objects include bookcases, heavy wall hangings, and building facades. Home water heaters pose a special risk due to their tendency to start fires when they topple over and rupture gas lines. Crumbling chimneys may also be responsible for injuries and proper damage.

Dam and bridge failures are significant risks during stronger earthquake events, and due to the consequences of such failures, may result in considerable property damage and loss of life.

Ground Displacement. Often the most dramatic evidence of an earthquake, especially in less developed areas, results from displacement of the ground along a fault line. The Borah Peak event generated a scrap face up to nine-feet in height. Utility lines and roads may be disrupted but damage directly attributable to ground displacement is generally limited. In rare instances, structure located directly on the fault line may be destroyed by the displacement.

Landslides and Avalanches. Even small earthquake events can cause landslides. Rockfalls are common as unstable material on steep slopes is shaken loose, but significant landslides or even debris flows can be generated if conditions are ripe. Roads may be blocked by landsliding activity, hampering response and recovery operations. Avalanches are possible when the snowpack is sufficient.

Liquefaction and Subsidence. Soils may liquefy and/or subside when impacted by the seismic waves. Fill and previously saturated soils are especially at risk. The failure of the soils can lead to possibly widespread structural damage. The oscillation and failure of the soils may result in increased water flow and/or failure of wells as the subsurface flows are disrupted and sometimes permanently altered. Increased flows may be dramatic, resulting in geyser-like water spouts and/or flash floods. Similarly, septic systems may be damaged creating both inconvenience and health concerns.

Seiches. Seismic waves may rock an enclosed body of water (e.g., lake or reservoir), creating an oscillating wave referred to as a "seiche." Although not a common cause of damage in past Idaho earthquakes, there is a potential for large, forceful waves similar to tsunami ("tidal waves") to be generated on the large lakes of the state. Such a wave would be a hazard to shoreline development and pose a significant risk on dam-created reservoirs. A seiche could either overtop or damage a dam leading to downstream flash flooding.

State Inventory of Past Events

General

From 1872, through the end of 2000, there have been over 2,000 recorded seismic events in the State of Idaho. The first recorded event, the “North Cascades Earthquake” on December 10, 1872, was located outside of the state but felt throughout the region.

Most of the recorded events are very small and generally not felt, typically registering under Magnitude 3.0. The vast majority of these minor events are associated with the Yellowstone hotspot and located in the West Yellowstone vicinity. Activity is also common in the central mountains (near Stanley) and in the southeast on the Wyoming and Utah borders.

Table 13 lists damaging earthquakes that have occurred in Idaho since records have been kept. The Borah Peak earthquake resulted in State and Federal Disaster declarations. The Hebgen Lake event is not included in this list as the epicenter was located in Montana. Both the Hebgen Lake and Borah Peak events are detailed below.

The Hebgen Lake and Borah Peak events are described in detail below. Appendix M contains a more complete listing of significant seismic events. Figure 4 illustrates the approximate locations of the epicenters of earthquakes that occurred in the region during the period 1872-1992.

Hebgen Lake

The Hebgen Lake earthquake (August 18, 1959) originated in Montana but was felt and caused considerable damage in Idaho. The magnitude 7.5 event generated Intensity X shaking, killed 28 people as a result of an enormous landslide, formed "Quake Lake," and did $11 million damage to roads and timber. Many campers in the Yellowstone area were trapped for days (and were eventually rescued with the assistance of smoke jumpers and helicopters) and a fishing lodge dropped whole into a lake. There were six aftershocks of Magnitude 5.5 or greater within one day and one of Magnitude 5.8 in 1964. The initial earthquake was felt in an area of over 450,000 square miles.

In Idaho, Intensity VII was experienced in the Big Springs, Island Park, Henry's Lake areas. Big Springs increased its flow 15 percent and became rusty red colored, and wells in the Island Park area remained muddy for weeks. A man was knocked down at Edward's Lodge and guests at Mack’s Inn experienced hysteria. There was considerable damage to buildings in the Henry's Lake area. Trees swayed violently, breaking some roots, and cars jumped up and down. Chimneys fell and a 7-foot-thick rock-and-concrete dock cracked.

Borah Peak

The Borah Peak earthquake (October 28, 1983) was the largest ever recorded in Idaho, both in Magnitude and in the amount of property damage. At a Magnitude of 7.3, it was also the largest earthquake to hit the continental United States in 24 years (since Hebgen Lake). The epicenter was in the Barton Flats area, approximately ten miles northwest of Mackay and thirty miles southeast of Challis.

Table 13 - Damaging Idaho Earthquakes

Date	Intensity*	Location
11/10/1884	VIII	Paris, Franklin County
11/11/1905	V	Near Shoshone, Lincoln County
10/14/1913	*V*	North-central Idaho
05/13/1916	VII	Boise

11/25/1924	VI	Near Wardboro, Franklin County
07/12/1944	VII	Near Sheep Mountain, southwest Idaho
02/14/1945	VI	Idaho City, Boise County
09/25/1947	VII	Boise, Ada County
12/19/1957	VI	Northern Idaho
08/07/1960	*VI*	Near Soda Springs, Caribou County
01/27/1963	VI	Clayton, Custer County
09/11/1963	*VI*	Central Idaho
04/26/1969	*VI*	Ketchum, Blaine County
03/28/1975	*VII*	Eastern Idaho
11/27/1977	VI	Cascade, Valley County
10/24/1978	VI	Southeast Idaho
10/14/1982	*VII*	Near Soda Springs, Caribou County
10/28/1983	IX	Borah Peak, Custer County

*Italics indicate approximate intensities determined from event descriptions.

The maximum observed Intensity was IX (based on surface faulting), and the earthquake was felt in an area over 330,000 square miles. Four aftershocks of Magnitude 5.5 or greater were recorded within 1 year and numerous more have occurred to date.

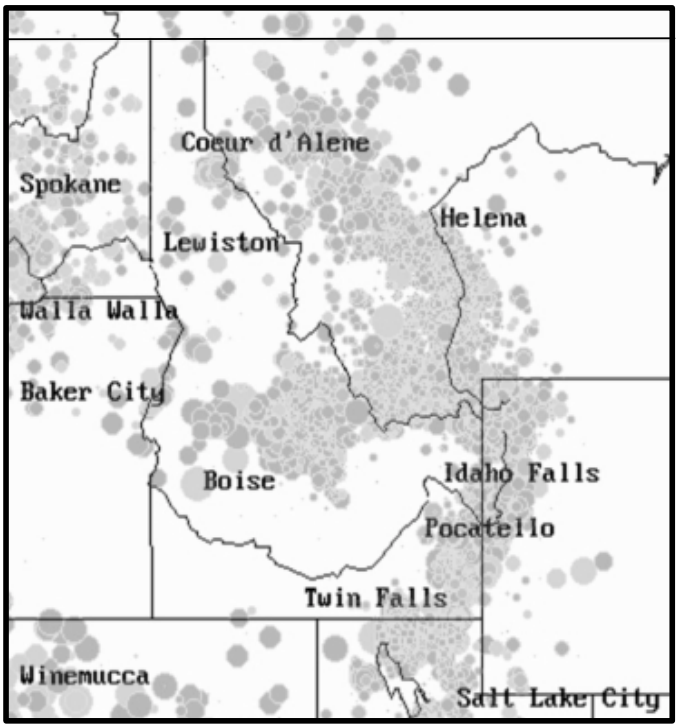
The event caused two deaths in Challis (both school age children) and several minor injuries. There was an estimated $12.5 million in damage in the Challis-Mackay area, affecting sewer and water systems, roads, other public facilities, and personal property. The facilities of an irrigation company and a fish hatchery also experienced extensive damage.

Although damage occurred as far away as Boise, the most severe property damage occurred in the towns of Challis and Mackay. Eleven commercial buildings, thirty-nine private houses, and one school sustained major damage. Two hundred houses sustained minor to moderate damage. Most of the damaged commercial buildings were of masonry construction, including brick, concrete block, or stone. The majority of the residential chimneys were cracked, twisted, or collapsed.

Significant ground displacement produced a twenty mile long zone of fresh scarps and ground breakage in the Lost River Range. Displacement along the fault ranged from less than 1.5 feet to 9 feet.

Other geologic effects included landslides and rockfalls, flow changes in springs, and fluctuations in water levels. A temporary lake was formed by the rising water table south of Dickey and widespread flooding occurred in the Warm Springs Creek area.

The event resulted in State and Federal Disaster declarations (designated *DR-697*). The declaration provided Public Assistance and Individual Assistance for Custer County, Individual Assistance for Butte County, and aid to schools in Butte and Gooding counties.



Source: Idaho Geological Survey, 1992.

Figure 4 - Historic Earthquake Epicenters, 1872-1992

Projected Occurrences

Idaho experiences hundreds of earthquakes every year, most of which are too small to feel. On average, Idaho experiences shaking strong enough to damage chimneys every ten years, and a more significant event about every twenty years. Intensity VII earthquakes are experienced in the region (in or adjacent to Idaho) every three to four years. This rate of occurrence is expected to continue. The 1991 Uniform Building Code (UBC), a nationwide industry standard, sets construction standards based on zones of seismic hazard. Based on these classifications, Idaho ranks fifth in the nation (behind only California, Nevada, Utah, and Alaska) for overall seismic hazard.[34]

All of Idaho's counties have moderate or higher seismic hazard risk. Thirty-eight counties contain areas of high to severe risk. The majority of the state's population is concentrated in high seismic risk areas, either along faults that define the margins of mountain ranges or in seismically active mountainous areas. Lifelines (e.g., utilities and transportation routes) and critical facilities (e.g., dams, government, military and research installations) are similarly at-risk.

Figure 5 illustrates the zones of shaking hazard for Idaho. In areas of Severe seismic shaking hazard, Intensity VII or higher can be experienced even on solid bedrock. In these areas, older buildings especially are at significant risk. Areas identified as High seismic shaking hazard can experience Intensity VII or higher where weaker soils or otherwise unstable ground exists.

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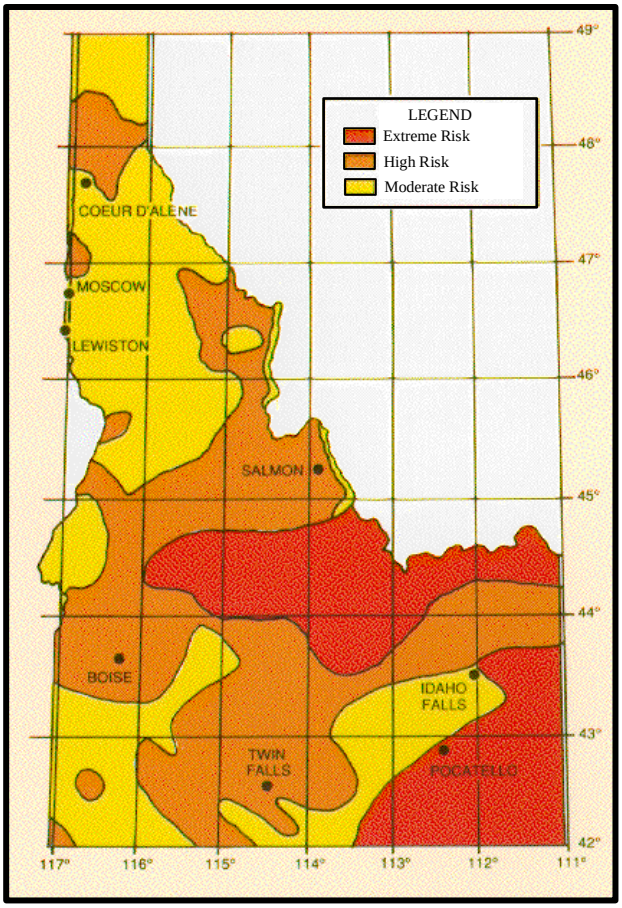
[34] Sprenke & Breckenridge, 1992.



Source: Idaho Geological Survey, n.d. (f).

Figure 5 – Seismic Shaking Hazard in Idaho

Hotspot-related seismic activity is confined to the Yellowstone region on the eastern border of the state. Dozens of small earthquakes (less than Magnitude 3.0) occur here each month, with larger events occurring about once a month.

Fault-related seismic activity occurs throughout the state but is concentrated in the central mountains and in the southeast corner. Idaho has a large number of known and suspected active faults. When identified, these faults can be useful for projecting future seismic activity.

The task of hazard assessment is complicated by the fact that there are many "hidden" or "buried" faults which will likely remain unknown until they demonstrate seismic activity. In general, only those faults that have been active since the last glaciation are exposed and have been identified. The rugged terrain of the state and limited resources of the scientific community have left large portions of the state without significant seismic investigation.

A combination of seismic activity and development on unstable soils along rivers and/or in valleys places Idaho's major urban areas at-risk:

- The Treasure Valley has major faults that have had movement as recently as 15,000 years ago. Known faults run in a band extending from Payette through Boise and Mountain Home to Twin Falls, extending as far south as the Owyhee Mountains on the Nevada border. The majority of these faults run northwest and southeast. Soils

in the Treasure Valley are alluvial (river-deposited) and provide amplification of the energy of an earthquake.

- The soils in the Pocatello area are also alluvial. Known faults run in a broad band from the Salmon area through the Idaho National Energy and Engineering Laboratory, Blackfoot, and Pocatello. This fault zone extends east into Wyoming and south to Salt Lake City.
- The Coeur d'Alene/Wallace area has known faults that run on an east - west trend through the valley. Much of Interstate 90 is build on top of the major fault in the area.

State-wide, Idaho's aging school facilities are a significant safety concern. Many were built prior to the adoption of modern codes and may not be able to withstand earthquake shaking. Unsafe structures are often built of unreinforced masonry posing the additional threat of falling bricks during events.

Hazard Mitigation

Policy Framework

Mitigation of earthquakes is established, generally, in the Idaho Disaster Preparedness Act of 1975 as amended (Idaho State Code Chapter 10, Title 46) and, more specifically, in the Governor's Executive Order, 2000-04. The Executive Order assigns primary responsibility for formulating and directing the state's geologic hazard reduction effort to the Idaho Geologic Survey. Duties include hazard identification, analysis and mapping of the geologic threats, and provision of representatives for hazard mitigation teams. [35]

The Executive Order also assigns the duties relevant to earthquakes: [36]

- Idaho Transportation Department - engineering support to State mitigation activities.
- State Department of Education – promotion of mitigation activities to reduce the risk from structural and nonstructural hazards in school facilities.
- Office of the State Board of Education - promotion of mitigation activities to reduce the risk from structural and nonstructural hazards in colleges, universities and area vocational-technical facilities.
- Idaho State Historical Society/State Historic Preservation Officer – promotion of mitigation activities to reduce the potential loss of the state's historic and cultural resources.
- Division of Building Safety - promotion and development of mitigation activities in conjunction with the Departments of Administration and Education and the Bureau of Disaster Services.

Existing Mitigation and Mitigation Planning Programs

State Government

The Idaho Geological Survey engages in a variety of research and educational tasks related to seismic hazards. The Survey also works closely with other agencies in planning state and regional earthquake policy and response, and participates in regional organizations such as the Western States Seismic Policy Council.

The Bureau of Disaster Services provides coordination, planning, training and resource

[35] Governor's Executive Order, 2000-04.
[36] Ibid.

support services to protect life, property and the environment before, during, and after earthquakes. BDS maintains and works towards completion of a five-year earthquake mitigation plan. This plan focuses on research, hazard awareness and training, standards adoption, and local planning.

BDS also participates in regional organizations such as the Western States Seismic Policy Council.

The Idaho Legislature enacted legislation in 1990 to assure that all new school buildings are checked for conformity with the Uniform Building Code which provides minimum earthquake safety standards.

The State, under the Governor's proclamation, holds Earthquake Awareness and Preparedness Month in April. This program serves as a focus for public education activities.

Federal Government

The National Earthquake Hazards Reduction Program (NEHRP) supports seismic research and development of engineering techniques and standards. Four agencies are signatory to the program: U.S. Geology Survey (USGS), Federal Emergency Management Agency (FEMA), National Science Foundation (NSF), and the National Institute of Science and Technology (NIST). USGS conducts and supports research that studies ground shaking and factors contributing to earthquakes, provides seismic hazard and risk maps, operates seismograph networks, investigates forecasting, and supports additional research. FEMA coordinates the NEHRP and spearheads mitigation activities through public-private partnerships, building codes and other seismic standards, loss estimation, and other related tasks. NSF supports research on a broad range of topics from human response to earthquakes to research on plate tectonics to the social and economic aspects of mitigation. NIST conducts research and development related to improving building codes, standards, and practices.

Idaho, despite its significant level of seismic hazard, has had difficulty obtaining funding for seismic research and monitoring due to its low population density. Only regional networks monitor earthquake activity in Idaho, so that there is no central seismic data analysis for the state.

Local

The State of Idaho a model building code, currently the Uniform Building Code (UBC). This code sets minimum life-safety standards for building construction based on regional seismic hazard. At the local level, adoption is at the option of the governing jurisdictions. When implemented by local public officials, the UBC provides the minimum structural requirements for the local earthquake hazards expected.

General Approaches to Mitigation

Hazard Management

Earthquakes affect large areas, even multi-state regions, making it difficult to effectively separate populations from seismic hazards. In general, earthquake mitigation involves building appropriately earthquake-resistant structures, public facilities, and infrastructure.

For older structures built before modern codes, retrofitting programs can be undertaken. Individual homes typically require securing to foundations and stabilization of chimneys. Steps can also be taken to secure shelving, cabinets, and suspended space heaters to reduce non-structural falling hazards and to secure water heaters (avoiding fires started by ruptured gas or electrical connections).

Information/Education

Much mitigation work (such as home retrofitting and non-structural falling hazard reduction) is dependent on property owner and resident action. Hazard awareness and education programs are necessary to lay the groundwork of knowledge that leads to this work.

Infrastructure

New public facilities and other infrastructure must be built to earthquake-resistant standards. The large stock of buildings constructed before 1992, is more problematic. Changes in occupancy, such as occurs when old commercial buildings are converted to restaurants, shops and apartments, provide opportunities for seismic retrofits. Extensive work is expensive, though, and hard to justify to building owners. Lifelines and critical facilities should not be concentrated in high risk areas.

Regulatory

Enacting the building codes and other regulatory measures is necessary to ensure that structures have earthquake-resistant construction.

Areas of known extreme hazard, such as fill soils and known faults, can be designated and zoned for open space or similar non-vulnerable uses.

The State could also provide incentives (e.g., tax relief) for proper owners to retrofit their homes and other properties. Insurance is typically very expensive and coverage is generally not required.

Mapping & Analysis

Accurate mapping of earthquake hazards is the first step in mitigation. Regional-scale fault maps and Uniform Building Code seismic zone maps are available for the state, but local-scale analysis can produce a more accurate understanding of hazards based on detailed soil and geology mapping.

Recommended State-wide Hazard Mitigation Actions

Hazard Management

SHMP-HM13	Change Purchasing Specifications for Non-structural Items to Include Seismic Safety
SHMP-HM14	Improve School Safety

Information/Education

SHMP-IE08	Conduct Educational Activities Regarding Buildings Techniques that Reduce Seismic Hazards
SHMP-IE09	Conduct Earthquake Educational Sessions in Idaho Schools
SHMP-IE10	Develop and Present a Rural Earthquake Project
SHMP-IE11	Continue the Annual Earthquake Awareness Month Campaign

Infrastructure

SHMP-IS03	Conduct Non-structural Hazards Evaluation of State Facilities

Regulatory

SHMP-RE05	Develop a Seismic Task Force
SHMP-RE06	Adopt State-wide Building Safety Codes
SHMP-RE07	Mandate State Tax Credits for Residential Mitigation Projects

Mapping & Analysis

SHMP-MA05	Coordinate Scientific Research to Support Seismic Hazard Mitigation Projects
SHMP-MA06	Involve the Five Highest-risk Urban Areas in Seismic Risk Assessment and Mitigation Planning

LANDSLIDING

Hazard Assessment

Fundamentals

"Landslide" is the general term for the movement of a soil and/or rock mass down a slope. It covers a variety of processes and landforms derived from those processes. In general the term "landsliding" will be employed in this document for general situations involving any of these processes.

Although all landslides may pose serious hazards, one type is of particular interest. These events, the "flows," including debris flows, are often difficult to distinguish from flash floods and possess similar destructive potential and rapid onset. Debris flows generally occur during periods of intense rain-fall or rapid snow-melt. They usually start on steep hillsides as shallow slides that liquefy and accelerate. The consistency of debris flows ranges from watery mud to thick, rocky mud that can carry large items such as boulders, trees, and cars. Material can be accumulated as they grow and flows from converging drainage may join together. When the flows reach canyon mouths or flatter ground, debris can spread over a broad area, sometimes accumulating in thick deposits.

Landslide Classification

Landslides may be classified by type of movement and material. An understanding of the types of landslides that occur is fundamental to assessing landslide hazard and evaluating potential mitigation measures.

A simplified differentiation based on the type of movement is:

- Falls: free falls of soil and rock with local rolling, bouncing, or sliding.
- Slides: lateral and downslope movement of partially intact masses.
- Flows: viscous flows of completely fragmented material, saturated with water.

Landslides can also be differentiated based the type of material involved.

- Rock: bedrock
- Debris: predominantly coarse material.
- Earth: predominantly fine material.

Together, movement and material produce a composite classification scheme. For exam-

ple, a free fall of bed rock is referred to as a "rock fall," while a viscous flow of predominantly fine material is referred to as an "earth flow." The wettest flows are referred to as "mud flows." These events may be very difficult to distinguish from heavily debris laden flash floods and functional are essentially the same.

Factors Contributing to Landslides

Natural Factors. Natural factors contributing to landslides include slope morphology (shape), slope material (soil), bedrock geology, vegetation, and climate.

Generally, the steeper a slope is, the more prone it is to landsliding (the exception comes when the slope is so steep that loose material does not accumulate). A study of landslides in central Idaho has shown that most slides occurred on slopes of about 30 degrees and that landslides were rare on slopes steeper than 41 degrees.[37] The general shape of a slope also influences the likelihood of a landslide. On a concave slope (e.g., hollow, swale, gully), water and debris tend to concentrate making landslides more likely. Conversely, on a convex slope (e.g., ridge, nose), water and debris are less likely to accumulate.

The slope surface materials and their underlying geology also determine landslide risk. A landsliding event is generally dependent on a material weakness. For example, if an impermeable layer exists, subsurface water will accumulate there, leading to reduced slope strength and a potential failure plane. The underlying and adjacent geology often influence the risk of landslides by controlling the movement of groundwater.

Vegetation contributes to slope stability in two ways. First, roots increase the shear strength of the slope material. Secondly, vegetation removes water from the hill slope by evapotranspiration. Therefore, burned watersheds are particularly vulnerable to landslides.

The climate of a region determines the frequency and magnitude of precipitation events. The size and timing of precipitation events has a great impact on landslide risk. It also influences the processes of rock weathering (important in influencing soil depth and strength), the type of vegetation that occupies the hill slopes, and the fire regime of the region.

Human Activities.[38] Some human activities and land uses can increase the potential for landslides. These include road construction, timber harvesting, grazing, mining, and long-term fire suppression. Such activities can contribute to slope instability by changing infiltration rates and groundwater movement, removing vegetation, and/or over-steepening slopes. In a study of 700 landslides in the Payette River drainage, less than three percent of observed recent landslides occurred on undisturbed sites, whereas the rest were associated with forest disturbances including wildfire, timber harvesting, and roads.[39] Irrigation and others forms of introduction of additional water (e.g., sprinklers, injection wells, and even septic systems) may be contributing factors to local slope instability. This may be critical along the Snake River canyon and near urban centers.

Placing roads on steep slopes has been widely identified as the single human activity most likely to increase the landslide hazard on a site. Roads increase the amount of bare soil and, if constructed across steep slopes, result in a portion of the road fill being steeper in gradient than the natural slope. Road construction on slopes also diverts groundwater to the surface, where it is concentrated and can obtain higher flow velocity. Mining activities can have similar impacts.

Landslide Triggers. An unstable slope will remain in place and intact until a landslide is triggered. Typical triggering events include (alone or in combination): water, seismic activity, volcanic eruptions, and the rapid ero-

[37] Megahan and others (1979), cited in Governor's Landslide Task Force, 1997.

[38] Material in this subsection taken from Governor's Landslide Task Force, 1997.

[39] Megahan and others (1979), cited in Governor's Landslide Task Force, 1997.

sion of the slope toe material (e.g., by stream down-cutting or road excavation).

The most frequent landslide-triggering mechanism is water from intense rainfall, rapid snowmelt, or human-introduced sources. A common cause of failure is the infiltration of water into the slope, which usually leads to an increase in ground stresses and a reduction of the soil's strength. Late spring-early summer is slide season, particularly after days and weeks of greater than normal precipitation. When water accumulates on the surface as runoff, a flow may be triggered. Flows in mountainous terrain are a year-round threat and may be triggered by heavy, brief rainfall during summer thunderstorms.

Seismic activity and volcanic eruptions, due to their infrequent natures, play a relative minor role in triggering landslides in Idaho. When these events do occur though, they can impact a large area and may trigger numerous unstable slopes. Floods are often accompanied by numerous landslides due to the wet nature and toe cutting.

Landslide-related Damages

Landslides threaten residences, businesses, transportation corridors, fuel and energy lines, and communication facilities. Landslides range from very small (affecting a single property) to massive, and their impact may affect only one slope or an entire drainage. A landsliding event may be composed of a single discrete landslide or numerous landslides over an entire region.

Landslide hazards may be classified as "on-site" and "off-site." On-site hazards correspond to landslides that originate on or near the development site. These are typically the slower moving and spatially limited falls and slides. Off-site hazards are those which begin on slopes away from the development and travel great distances or cover large extents. These are typically the flows or, in some cases, massive slides. Both on-site and off-site landslides may impact lives, property, and the environment.

A possible secondary hazard in Idaho is a "seiche," a damaging wave triggered by landsliding into lakes. Seiches, similar in effect to tsunamis, can damage or destroy shorefront property, docks, and boats.

State Inventory of Past Events

Idaho's geology, landscape, climate, soils, and other factors are locally conducive to landslide activity and numerous landslides occur each year in Idaho. Many of these, though, are small events whose impacts are not well documented. The Idaho Geological Survey has identified and plotted over 3,000 major landslides in the state. Landslides are also included on local and regional geologic maps and other geologic sources.

Significant landslide events (those resulting in disasters) are rarer but several have been recorded in the state. Prior to 1976, major events had a significant impact on transportation, communities, and natural resources in 1919, 1934, 1948, 1964, 1968, and 1974. Table 14 lists State and Federal Disaster declarations related to more recent landslides (the period 1976-2000).

Seiches are uncommon but do occur. They produced damage to docks and some boats around Lake Pend Oreille (at Bayview and Sand Point) in 1946 and 1963.

There is no reliable estimate of total landslide costs and losses in Idaho, but these events are costly. For example, ongoing landslide problems magnify the challenges of maintaining U.S. 95, the primary north-south link in the Panhandle region. It is often impossible to redirect traffic on this heavily traveled road as alternate routes do not exist, and detours in steep terrain are difficult or impossible to construct. Landslides here disrupt emergency functions and commerce, as well as personal lives. Some of these impacts can be quantitatively measured (e.g., lost business) while others, such as disruption of families, is impossible to quantify.

Federally Declared Disasters

Northern and Central Idaho, 1996-1997. During late December, 1996, above-normal snowfall occurred in Northern and Central Idaho and was quickly followed by significant amounts of warm rain. The melting snow and heavy rains overwhelmed rivers and their tributaries, leading to widespread landslides and severe flooding mainly in the West-Central region of the state. Large sections of the highway system were damaged or destroyed, isolating several communities for days. Six deaths and three serious injuries were attributed to this disaster.

Table 14 - State Disaster Declarations for Landslide Events 1976-2000

Year	Month	Federal	Counties Affected
1982	July		Boise
1986	February		Boise
1986	March		Boise, Elmore, Lewis, Nez Perce, Owyhee
1991	April		Bonner
1996 - 1997	November - January	X	Adams, Benewah, Boise, Bonner, Boundary, Clearwater, Elmore, Gem, Idaho, Kootenai, Latah, Nez Perce, Owyhee, Payette, Shoshone, Valley, Washington
1997	March – June	X	Benewah, Bonner, Boundary, Kootenai, Shoshone*
1998	May		Lemhi, Nez Perce, Washington
	October		Boundary
2000	June**		Kootenai

* Additional counties in the southeastern portion of the state were added to the declaration at a later date but damage there was related to flooding only.
** This event occurred in January but was not declared until June.

Massive landslides and floods occurred in the Payette, Weiser, and Little Salmon river basins, causing extensive damage to structures, roads, and bridges. Boise County in particular experienced substantial landslide damage. Numerous soil failures on saturated faces of hillsides resulted in major landslides and mud flows. There were numerous small landslides that obstructed culverts, flowed over roads, and caused undercutting on the downhill side.

Numerous debris flows occurred throughout Western Idaho causing extensive damage. Deposits left by these flows were several feet in depth, up to 300 feet wide and they overwhelmed the 1-3 foot culverts designed to pass rainfall runoff. Several gulches had significant slides that overwhelmed structures built on the alluvial debris flow fans. A massive debris flow hit the community of Lower Banks flowed down from an area burned over in 1992. The slide deposited mud, rocks, and debris at the base of the slope and expanded to cover all of the community. Most buildings (residential and business) appeared to be damaged or destroyed. Buildings were moved from their foundations and submerged in mud up to two-thirds of the building's height. Many public facilities were damaged or destroyed.

From Horseshoe Bend to Banks, US Highway 55 was restricted for one week. Several slides occurred in a half-mile section near Banks with the largest estimated at 100,000 cubic yards. Highways 17 and 21 were closed by landslides, isolating the communities of Lowman and Garden Valley. On Old Idaho 17 there were miles of highway with landslides every 200-500 feet. US 95 experienced eleven washouts that isolated residents for days, and McCall was isolated, suffering economic hardship due to disruption of its winter recreation activities. Local roads and forest access were likewise affected. Mudslides destroyed much of the 6,000-mile road system in the Boise National Forest, threatening fisheries and access to popular recreation areas in the spring.

On January 4, 1997, the President declared a major disaster (designated as *DR-1154*) in the State of Idaho; eighteen counties were declared eligible for Federal assistance. As of February 1, 2001, assistance included $19,404,105 in public assistance, $39,988 in individual assistance, $125,937 from the NRCS, $576,314 from the Army Corps of Engineers, and $5,593,892 in hazard mitigation grants.

Much of the impact of these landslides occurred on virtually unpopulated public and private lands managed by the Forest Service, Bureau of Land Management, Idaho Department of Lands, and Boise-Cascade Corporation. In addition to damage to infrastructure (e.g., forest roads), the impact also represented a large input of sediment and woody debris into stream channels. The increased sediment input into the stream channels affected fish habitat. Based on past studies, it is suspected that road construction played a large role in the origin of these slides. Recent wildfires may also have played a role in the extent and severity of the landsliding by (1) reducing root strength, (2) reducing transpiration by plants, and (3) increasing runoff due to reduced infiltration.

Northern Idaho, 1997. In early March 1997, northern Idaho received 12 to 18 inches of snow on top of an existing snowpack that exceeded 150-170% of average. A rainstorm followed which resulted in a rapid snow melt. The resulting mudslides and flooding lasted for an extended period and damaged many public facilities including county road systems. The President issued a Federal Disaster declaration (DR-1177) on June 13, 1997 for Boundary, Bonner, Benewah, Kootenai, and Shoshone Counties.

Other State Disasters

Bonner County, 1991. The damaging event that occurred near Sandpoint in April 1991, well illustrates the somewhat confusing continuum between flash floods and debris flows. Although classified in the State declaration as a flash flood, the high debris load makes it somewhat indistinguishable from a debris flow. The torrents blew out large sections of the road leading to Schweitzer Basin ski area stranding dozens of people, contaminated the city's primary water supply, and heavily damaged the water treatment facility. The cost to cleanout and repair the water treatment facility ran to several hundred thousand dollars.

Kootenai County, 2000. A major landslide January 30, 2000, blocked the only access road to Ravens Point (near Bayview). A second rockslide two days later exacerbated the problem. Access to 75 homes was cut off. Kootenai and Bonner counties, Timber Lakes Fire District, and Lakes Highway District provided essential services. Residents shared personal resources and maintained communication through a specially designed web page. A 65-passenger ferry was leased for travel to and from Bayview. Governor Kempthorne and the Legislature authorized up to $725,400 for BDS to reimburse local agencies. The Natural Resources Conservation Service provided much needed federal assistance in stabilizing the banks above the lake and removing road blockage. The state paid the non-federal match required by NRCS. The request for presidential disaster declaration was disapproved.

Boundary County, 1998. One October 19, 1998, a mudslide covered Highway 95 one mile north of Bonner's Ferry. Additional slid-

ing the next day caused extensive damage to the State highway, a county road, and 1,000 feet of Union Pacific Railroad tracks. The blockage eliminated emergency medical and fire services for half the county. Truck traffic was rerouted 112 miles around the slide and up to five trains a day were stranded. The Governor declared a Disaster (due to economic impact) on October 17.

Nez Perce County, 1998. Landsliding that begun on May 4, 1998, blocked Snake River Avenue in Lewiston, restricting access to some businesses. A second slide on May 13, destroyed a mobile home and caused an additional road closure. The Lewiston Elks Temple was also threatened by ongoing slide activity in the vicinity. Total public costs for this event are estimated at just under $4.5 million; approximately four million dollars for Idaho Transportation Department and $485,000 for Nez Perce County.

Other Landslide Events

Gooding County, 1993. On July 24, 1993, approximately 100 acres of ground failed and slid into the Snake River just south of Bliss. The river was temporarily dammed and a new set of rapids was created. The access road to the south side of the river was destroyed. The initial slide and subsequent erosion of the toe introduced a large amount of sediment into the river. The landslide site shows extensive evidence of earlier activity.

Twin Falls County, 1999+. The Bluegill Landslide (near Buhl on Salmon Falls Creek, 5 to 10 miles from its confluence with the Snake River) was first noted during the summer of 1999, when local rock climbers noted changes in the bedrock cliffs, an unusual amount of rock fall, and fractures opening up on the trail. Subsequently, a twelve-acre block of canyon rim, composed of basalt and sediments, has begun sliding into Salmon Falls Creek. This slide activity may threaten irrigation pumping stations and may generate flood risks to upstream and downstream development. The slide is still active and moving.

Hagerman Fossil Beds National Monument, 1979+. A series of major landslides have struck the plateau along the Snake River located in Hagerman Fossil Beds National Monument since 1979. These large slope failures have occurred approximately every two years, and typically affected areas ranging in size from 300 to 800 feet wide and up to 1000 feet long. The 1987 event destroyed a million-dollar irrigation pumping facility and nearly killed two workers.

Projected Occurrences

Landslides are essentially localized events. Establishing the likelihood and potential magnitude of events at specific sites requires detailed site analysis and can be a time-consuming and expensive process. It is therefore extremely difficult to generate a statewide projection of future landslide activity and disasters. Some generalizations may be made, though, and geologist and planners can identify zones of potential landslide hazard based on geology, topography, and climate through broad-brush analyses.

The geology of the central, western, and Panhandle regions of the state lends itself to landslide-prone terrain. Large and damaging landslides may be expected to continue to occur.

Most landslide-prone areas have steep slopes and of significant length. Although these characteristics are often associated with the mountainous areas of the state, localized occurrences may be found throughout the state. Even in the relatively flat Snake River Plain and Owyhee County regions, numerous landslides occur along the near-vertical walls of deeply-incised river canyons.

Many landslides are associated with precipitation events and/or saturated soils. Throughout the state, these conditions may be expected to occur in the winter (heavy rain storms), spring (during snow melt), or summer (significant thunderstorms).

In the evaluation of local sites, the conditions that lead to landsliding are generally understood and predictable. The factors contribut-

ing to landslides described above (natural factors, human activities, and landslide triggers) should all be considered when evaluating hazard. Additionally, significant damage often occurs in areas that show evidence of either past landsliding. An evaluation of past activity can be a powerful projection tool.

Landslides may be expected to occur throughout the state where local conditions are favorable. However, these events generally only have disastrous consequences when they occur in populated areas or intersect infrastructure such as highways.

Consequently, the mountainous areas of the state are most at risk from future landslide activity. In these areas, considerable development of communities, transportation systems, and supporting infrastructure have been located in steep canyons and alluvial fans close to rivers. Development of forest and mineral resources has also resulted in the construction of roads in steep and potentially unstable terrain. Recent population growth has caused development to occur more frequently in hazard areas. This trend is expected to continue in the near future.

Hazard Mitigation

Policy Framework

Mitigation of landslides is established, generally, in the Idaho Disaster Preparedness Act of 1975 as amended (Idaho State Code Chapter 10, Title 46) and, more specifically, in the Governor's Executive Order, 2000-04. The Executive Order assigns primary responsibility for formulating and directing the state's geologic hazard reduction effort to the Idaho Geologic Survey. Duties include hazard identification, analysis and mapping of the geologic threats, and provision of representatives for hazard mitigation teams. The Executive Order also assigns the Idaho Transportation Department responsibility for providing engineering support to State mitigation activities.[40]

Additional policy guidance is provided by *Recommendations for Idaho Communities, Infrastructure, and Resources at Risk from Landslides and Related Events*, a document produced by the Governor's Landslide Task Force, July 1997. The Task Force was composed of representatives from federal agencies, state agencies, and the private sector with expertise in and a commitment to reducing the impact landslides, mudflows, and debris flows have on the state's citizens. The Task Force's goal was to prepare recommendations for identifying the threat, defining its consequent risk, and proposing strategies for minimizing the impact of future landslides. Ten recommendations that the Task Force felt to be critical to coping with landslide hazards in the state were generated:[41]

- Implement a state-wide landslide mitigation plan that would encourage and support local mitigation efforts.
- Assess landslide hazards and produce landslide hazard maps of critical areas.
- Implement avoidance measures for landslide-prone areas including (a) legislation, regulations, ordinances, and zoning to mitigate slope instability contributed by excavations and drainage; and (b) site investigations to define hazards.
- Establish a lead agency to take responsibility for making emergency warning notification.
- Initiate field-based, interdisciplinary technical studies of landslide processes to improve hazard assessment techniques.
- Implement guidelines for activation of geotechnical-oriented rapid response teams.

[40] Governor's Executive Order, 2000-04.

[41] Governor's Landslide Task Force, 1997.

- Assist cities and counties with funding and technical assistance to implement mitigation activities.
- Update and maintain existing state-wide landslide database and provide for periodic surveillance in problem areas.
- Implement a public awareness campaign about landslides.
- Develop a method for prioritizing landslide mitigation projects.

Much of this chapter is based on the work of the Landslide Task Force.

Existing Mitigation and Mitigation Planning Programs

State Government

There are currently no State programs or resources designed solely or specifically for landslide mitigation. The Bureau of Disaster Services provides mitigation opportunities through Federally-funded programs such as the Hazard Mitigation Grant Program. The Idaho Transportation Department (ITD) provides engineering expertise and resources for the execution of projects when needed. The Idaho Geological Survey and the University of Idaho provide technical assistance for projects. In particular, the IGS has extensive data which it can make available for mitigation purposes.

Federal Agencies and Institutions

The Federal government provides mitigation assistance through ongoing infrastructure programs such as those of the Federal Highway Administration and through special grants and other emergency assistance programs such as those of the Federal Emergency Management Administration. Additionally, the Federal government has available a significant resource base of technical assistance. Specifically, the Geologic Division of the USGS has a Landslide Hazard Program designed to help states deal with emergency issues.

Local

At the local level in Idaho, resources to address landslide needs typically come from city, town and county governments and highway districts. The type and amount of available resources depend on the size of the government operations; specialized technical expertise will also vary among local governments.

Private and quasi-private individuals and groups are also involved in landslide mitigation. For example, private assistance was provided for the Boise Foothills fire recovery efforts in 1996, and the Potlatch Corporation cooperated with the U.S. Forest Service in the investigation of landslide issues in the Clearwater National Forest.

General Approaches to Mitigation

Landslides are site-specific hazards that may be influenced by off-site conditions (e.g., inappropriately channeled runoff) and may have large-scale consequences (e.g., the disruption of transportation routes or contamination of water sources). Mitigation must balance the need for very localized action with the potentially regional benefits. The State may need to take a role in what is otherwise perceived as a local issue.

As with all hazards, the preferred method of mitigation is to separate human development and population from hazard-prone areas. When this is not possible or practical, a variety of measures may be employed to reduce the potential impact of events on property and lives.

Some landslide hazards cannot be mitigated or are too costly to mitigate and, therefore, are best avoided. Other landslide-prone areas are easily mitigated and need not influence land use significantly as long as the hazard is identified. Because of this, general landslide hazard information should be utilized in developing local master plans and zoning ordinances so that land use can then take into account landslide hazards.

Hazard Management

There are two basic approaches of hazard management: diversion of debris and landslide/slope stabilization. The choice of mitigation approach should be based on a thorough investigation of the site in order to evaluate all pertinent characteristics of a specific landslide.

Diversion of Debris. Mitigation by diversion of the landslide debris involves redirecting the debris from its runout path to avoid damage to existing development.

Landslide/Slope Stabilization. Mitigation by stabilization of a landslide or an unstable slope area may involve any one or more of three strategies:

- Drainage control: conveyance of surface and shallow ground water away from the site.
- Regrading of the hazard area: removing soil from the slope in order to reduce the weight of the slide mass and lower slope gradient, both of which will increase slope stability.
- Mechanically restraining slope movement: vegetation or armoring of slope surfaces or construction of retaining walls.

Information/Education

Many property owners and residents are unfamiliar with the landslide hazard associated with their property and homes. Relatively small steps in home construction and landscaping can play a large role in hazard reduction. As with all natural hazards, public information and education is the first line of defense, not only increasing the knowledge of the problem but also gaining higher compliance with regulatory and voluntary mitigation measures.

Infrastructure

Infrastructure should be constructed so as to avoid landslide hazard areas. Where infrastructure elements (e.g., roads) and public facilities are at direct risk from landslides, steps should be taken to mitigate the hazard (through debris diversion of slope stabilization) or provide for functional backups.

Regulatory

The generally preferred method of landslide mitigation is avoidance of hazard areas. Mitigation by avoidance involves designation of landslide hazard area buffers and building setbacks or, in more extreme cases, may involve the total restriction of use or occupation within the hazard area.

In addition to restricting new development from hazardous areas, regulations can require that landscaping and construction activities do not contribute to slope instability. This step can help minimize the impact on existing development and avoid increasing the extent of hazard areas.

When landslide regulations are developed, the first step is to identify potentially hazardous areas. Geo-technical investigations performed by qualified engineering geologists and engineers are required to address hazards and recommend appropriate action prior to development in “potentially hazardous areas.”

Mapping & Analysis

Accurate mapping of landslide hazards is the first step in mitigation. This analysis depends on knowledge of the area’s geology, topography, climate, and land management. Developing a comprehensive database is a key priority in the mitigation effort.

Recommended State-wide Hazard Mitigation Actions

Hazard Management

SHMP-HM15	Provide Funding for County Debris Retention and Collection Systems

Information/Education

SHMP-IE12	Develop a Comprehensive Landslide Awareness Campaign

Infrastructure

SHMP-IS02	Enhance Road Drainage Systems
SHMP-IS04	Assist Counties in Mitigating Infrastructure at Risk

Regulatory

SHMP-RE08	Improve Local Management of Landslide Hazard Areas
SHMP-RE09	Prohibit the Construction of Public Facilities in Landslide Hazard Areas

Mapping & Analysis

SHMP-MA07	Develop a State-wide Landslide Hazard Assessment
SHMP-MA08	Update the Idaho Landslide Information Database

OTHER HAZARDS

Avalanches

Hazard Assessment

Fundamentals

An avalanche is a mass of snow (and possibly other debris) in motion down a slope. Avalanches can only occur where snow can collect on steep slopes – in Idaho, they are found in the mountainous portions of the state. Avalanches occur rapidly, can be difficult to predict with certainty, and are sometimes initiated by their victims.

Avalanches generally occur in a cyclical manner each year through the winter and spring. Events normally recur on the same slope time and again (known as the "avalanche path"), varying in size and frequency based on snow accumulation and other weather factors. Unusual weather can lead to departures from normal path and characteristics, and under the right conditions even historically "stable" slopes can pose significant risk.

Snow, like water, is directed by gravity, and will generally follow the easiest path down a slope. Avalanche paths are often comprised of steep gullies and open slopes. Ridges, rocky outcrops, and slope terraces can confine, slow, and stop avalanches. The most dangerous avalanche path is one that begins broad and funnels into a narrow gully, where snow may be deposited very deeply at the bottom of the slide.

Avalanches can range from very small, "sluffs" (which by definition do not run more than 150 feet), to very large (capable of devastating entire mountain communities). They may include a section of the accumulated snow (the "snow pack") or all of it, leaving behind bare ground.

The anatomy of an avalanche is composed of three zones:

- Release Zone – the top of the slide, where the snow mass breaks free and accelerates,
- Track – the middle of the slide, where the mass moves at a roughly constant velocity.
- Runout Zone – the bottom of the slide, where the mass slows and is deposited.

When avalanche material is deposited in the runout zone, it tends to harden. Even very light avalanches of powder dry snow can form concrete-like masses after being "worked" by the mechanical forces involved in the slide. Victims are rarely able to extract themselves from even very shallow burials.

Factors Contributing to Avalanches

Avalanches essentially result from a combination of snow accumulation (the "snowpack"), steepness of slope, and slope failure.

Snow is typically deposited throughout the winter season and melts through the spring. The details are of course more complicated, as the snowpack undergoes a number of periods of accumulation and shrinkage. The periods during and immediately after major storms generally have the highest probability of avalanche occurrence.

Wind can be a major factor in the creation of avalanche conditions. Wind can carry falling snow and previously deposited snow and deposit it in great depths in certain locations (a process known as "wind loading"). Generally, snow is removed from the upwind ("windward") side of a slope or ridge and deposited on the downwind ("lee") side.

Avalanches most commonly occur on slopes with a steepness between 20º and 55º. The majority are found on 30º to 45º slopes. Shallower slopes lack sufficient angle to allow motion; steeper slopes are generally too steep for snow to accumulate.

There are two basic forms of avalanches as defined by the nature of the slope failure, "loose snow" and "slab." Each has unique characteristics that determine its impact on property and lives.

Loose Snow Avalanches

Loose snow avalanches originate at a point and propagate downhill by dislodging successively larger amounts of poorly bonded snow grains. The initial release may result from the settling of newly fallen or melting snow or from an external trigger. These slides will typically grow in width as they move downslope.

Loose snow avalanches usually involve limited snow mass and cover a relatively small area. When formed from snow with large amounts of liquid water (such as in spring melt), they can be quite heavy and dangerous.

Slab Avalanches

Slab avalanches are cohesive (well-bonded) masses of snow that release all at once. These slides may be either "hard," remaining as a coherent mass, or "soft," breaking up in very small pieces but still traveling as a unit. Slab avalanches occur only when four essential elements are present:

- Slab – a cohesive mass of snow, resulting either from a single heavy snow fall or "metamorphosis" (physical change due to snowpack depth, temperature, and water content) of the snowpack.
- Instability – a weakness in the snow pack that allows the slab to break free of the adjacent and underlying snow.
- Sliding Layer – an appropriate surface, either within or below the snowpack, on which the slab may slide (e.g., cohesionless snow crystals or liquid water)
- Trigger – a factor, either internal or external to the snowpack, that causes the weakness to fail; the majority of slab avalanche victims trigger the slides that catch them (e.g., a snowmobiler riding onto the slab and introducing additional weight and mechanical forces).

The snowpack fracture that defines the slab may propagate for long distances across the surface and extend deeply into the snowpack. Huge volumes of snow may be involved in the avalanche. Slab avalanches account for the majority of avalanche fatalities. Although conditions can be assessed as to a general probability of slab avalanche occurrence, specific prediction on most slopes is very difficult.

Avalanche-related Damages

The majority of avalanches involving people occur in the backcountry, away from development, and involve a single party of recreational users. Avalanches kill and injure through burial and mechanical impact. Two-thirds of avalanche fatalities are due to suffocation; the majority of the rest are due to trauma (especially to the head and neck). Even small slides can carry victims over cliffs or into narrow gullies where deep burial is possible. North American statistics suggest that a completely buried victim has a fifty percent chance of survival if rescued within thirty minutes, with a rapid decline thereafter. Less than one-third of completely buried victims are recovered alive.[42]

Avalanches in the state associated with property damage typically occur on transportation facilities such as highways and railroads. Road closures are not uncommon and vehicles are lost on occasion. The economic costs of these disruptions can be significant, especially in areas with limited access options. Forest resources, such as timber and wildlife habitat, may also be impacted by significant slides.

State Inventory of Past Events

Avalanches are unique to mountainous terrain. In the 19th and early 20th century, mining and transportation-related activities (e.g., railroad construction and travel) accounted for a majority of the damages and casualties from avalanche events. Few individuals not engaged in these activities found themselves in hazardous locations. Subsequent reductions in backcountry mining activity and improvements in transportation-related avalanche safety lead to a decline in avalanche damages and casualties.

In the later half of the 20th century, the mountainous backcountry began to be visited in the winter again, this time by recreational users. These users, including skiers, snowboarders, snowshoers, hikers, and snowmobilers, now account for nearly all avalanche casualties. The vast majority of these occur outside of avalanche-patrolled and controlled areas. In almost all cases, avalanche victims or their parties trigger the slides that catch them.[43]

The Colorado Avalanche Information Center reported thirty-three fatalities in Idaho for the period winter 1950/51 to winter 1996/97.[44] Snowmobiling is currently the leading cause of avalanche fatalities in Idaho. Idaho State Parks reports eight snowmobiler fatalities dur-

[42] LaChappele, 1985.
[43] Tremper, 1999.
[44] Colorado Avalanche Information Center, n.d.

ing the period winter 1997/98 to winter 2000/2001.[45] Slab avalanches account for almost all avalanche fatalities.

Avalanches still close transportation routes in mountainous areas, although damage and loss of life are rare. The nine-mile section of Highway 21 between Grandjean Junction and Banner Summit, called Canyon Creek, has fifty-four avalanche chutes and experiences about ninety percent of the highway-impacting avalanches in the state.

It is impossible to state the number of avalanches of all sizes that occur in the state each year. Small avalanches occur throughout the winter and spring, but do no damage. Typically, avalanche activity that does not result in serious injury, death, or significant property damage is not reported.

There have been no State or Presidential Disaster declarations arising from avalanches.

Projected Occurrences

Recent historical levels of avalanche events may be expected to continue. Based on avalanche fatality data for the period winter 1950-51 through winter 1987-88, Idaho is rated as a moderate avalanche hazard severity relative to other states.[46]

The past decade has seen a substantial increase in the number of winter backcountry recreational user. A continuation of this trend can be expected to be accompanied by an increase in the number of avalanche events that result in injury and death unless offset by training and preparation.

Hazard Mitigation

Policy Framework

Mitigation of avalanches is established, generally, in the Idaho Disaster Preparedness Act of 1975 as amended (Idaho State Code Chapter 10, Title 46) and, more specifically, in the Governor's Executive Order, 2000-04. The Executive Order also assigns the Idaho Transportation Department responsibility for providing engineering support to State mitigation activities related to avalanches.[47]

Existing Mitigation & Mitigation Planning Programs

Mitigation of avalanche hazards takes four forms in Idaho:

- Safety testing and road closures by Idaho Transportation Department.
- Avalanche hazard monitoring and forecasting, broadcasting of public information, and avalanche safety education by three USDA Forest Service avalanche centers.
- Avalanche control work at developed ski areas.
- Zoning ordinances that restrict development in hazardous areas.

Idaho Transportation Department monitors avalanche conditions in mountainous areas, closing sections of roads when the potential for avalanche activity rises. The majority of this activity is associated with Highway 21 near Banner Summit.

Four avalanche centers operated by the USDA Forest Service and supported by private non-profit organizations provide hazard monitoring and forecasting, broadcasting of public information, and avalanche safety education. The Sun Valley Avalanche Center serves the Sawtooth and Wood River Valley areas, the Payette Avalanche Center serves the western central portion of the state, the Idaho Panhandle Avalanche Center serves the Panhandle area, and the Bear River Avalanche Information Center (operating the Logan office of the Utah Avalanche Forecast Center) serves the southeastern mountains. These centers collect data through remote instruments, field work, public observations, and National Weather

[45] Stuebner, n.d.
[46] National Research Council, 1990.
[47] Governor's Executive Order, 2000-04.

Service (NWS) information products to generate hazard forecasts. Avalanche and mountain weather advisories based on these forecasts are made available through phone lines and WWW sites. The centers also provide education for recreational users of the backcountry and avalanche awareness for the general public. When avalanche hazards are High to Extreme, the NWS office in Pocatello helps disseminate snow avalanche reports by issuing a Snow Avalanche Bulletin.

Avalanche control work at developed ski areas includes hazard evaluation, closures, and hazard reduction. Hazard reduction is most commonly accomplished through controlled release of hazardous slopes using explosives. It should be noted that the lack of avalanche deaths and injuries in developed ski areas results from intensive hazard control work rather than natural conditions. Without these significant ongoing mitigation efforts, many more hazardous avalanche events would occur.

Avalanche mitigating zoning ordinances have been adopted in Idaho. In Ketchum, the municipal government maintains an avalanche zoning ordinance that pays particular attention to the "duty to warn" by providing that the public be notified of avalanche potential within all designated avalanche areas, as determined by detailed studies.

General Approaches to Mitigation

Hazard Management

Avalanche hazard can be mitigated in three ways:

- Terrain modification.
- Snow cover modification.
- Human behavior modification.

Terrain modification involves changing the ground surface or building structures in the release zone and/or track to prevent the release or stop the natural run of an avalanche. Possible mitigation techniques include: retention, redistribution, and retarding/catchment structures and reforestation.

- Retention structures, which prevent an avalanche release, include snow rakes, snow bridges, and nets. These structures are generally limited to areas with limited snow packs and may create negative aesthetic impacts.
- Redistribution structures, snow fences and similar techniques, reduce snow drifting and control the buildup of large snow loads.
- Retarding/catchment structures stop, divert, confine, or slow slides. These include ditches, terraces, dams, and mounds constructed into the ground surface. Some have been effectively carved into existing, stable snowpacks to mitigate slides of later snow accumulations.
- Reforestation provides a natural form of protection. Many of the above structures can be simulated with vegetation.

Snow cover modification involves modifying the snowpack, either through stabilization or controlled release, to prevent releases or minimize the volume of snow included in an avalanche. Stabilization can be accomplished through compaction, which may be performed by grooming equipment. This technique is most effective early in the season. Controlled release of potential avalanche slopes is the most common technique for reducing avalanche hazard. Slopes are generally triggered through the use of explosives delivered by hand, aerial bombing (primarily helicopters), and artillery (the predominant method of avalanche control in the U.S.).

Human behavior modification involves rendering avalanches harmless by keeping people out of their paths. It can also reduce the number of avalanche occurrences by eliminating potential triggers (people). Techniques include closure of recreational areas and relocation of residences and businesses from hazardous areas.

Information/Education

The highly mobile nature of winter backcountry recreational use makes structures and control work impossible. Training in avalanche

hazard evaluation, safe travel, and rescue techniques can reduce the number of injuries and fatalities. Information should be made available to the general public as well.

Infrastructure

In areas where there is a significant threat of avalanches impacting a State road, an active program of avalanche forecasting and mitigation should be maintained.

Regulatory

Land use and zoning ordinances can be used to restrict development in hazardous areas.

Mapping & Analysis

As with all hazards, mitigation of avalanche hazards is dependent on an accurate mapping of the hazard. Avalanches tend to follow well defined paths so mapping in limited areas is an achievable goal.

Recommended State-wide Hazard Mitigation Actions

Information/Education

SHMP-IE14	Develop a Comprehensive Avalanche Awareness Campaign

Infrastructure

SHMP-IS05	Implement Avalanche Control for Frequently Closed Highways

Drought

Hazard Assessment

Much of the material for this section is taken from the Idaho Drought Plan (1995). This plan outlines a variety of policies and actions that could be incorporated across the state in the event of a drought. Readers are referred to this document (or its successor) for a more detailed treatment of droughts.

Fundamentals

Despite its long agricultural history, Idaho is correctly classified as an arid area with long droughts. Drought can be simply defined as a period of abnormally dry weather leading to a serious water shortage which results in consequences such as loss of standing crops and unmet consumptive water needs of people and livestock. Although defined by "abnormally" dry weather, droughts are a normal part of Idaho's climate and can be expected to reoccur periodically.

Droughts in Idaho are generally associated with a sustained period of low winter snowfall. This results from a temporary, yet significant, change in the large-scale weather patterns in the Western U.S. The limited snowpacks result in reduced stream flows and ground water recharge. Idaho's system of reservoirs and natural storage can buffer the effects of minor events over a few years, but a series of dry winters (or an especially pronounced single low snowfall event) will result in a shortage of available water. Extended periods of above average temperatures during the spring and summer can increase the impacts of low snowpacks.

Droughts can have the broadest effect of all of Idaho's hazards, sometimes affecting all regions of the state simultaneously. Although deaths and injuries rarely directly result, widespread events can have significant impacts on the economic, environmental, and social well-being of the state.

Idaho's strong dependence on resource based industries makes the state economically vulnerable to droughts. Losses ripple through the economy and may result in serious long-term consequences. Economic impacts may include:

- Losses from crop, dairy and livestock, timber, and fishery production and associated businesses.
- Loss from recreation providers and associated businesses.
- Losses from increased costs resulting from increased energy demand and from shortages caused by reduced hydroelectric generation capacity.
- Revenue losses to federal, state, and local governments from reduced tax base and to financial institutions from defaults and postponed payments.
- Losses from impaired navigability of streams, rivers, and canals.
- Long-term loss of economic growth and development.

Droughts in Idaho can also have significant impacts on the natural environment. Specific impacts may include:

- Damage to habitat, reduction of feed and drinking water, disease, increased vulnerability to predation for wildlife and fish.
- Wind and water erosion of soils.
- Damage to plant species.
- Reduction of water and air quality.
- Reduction of visual and landscape quality.

Social impacts may include:

- Increased risks to public safety from forest and range fires.
- Increased conflicts between water users.
- Food shortages and increased health concerns.
- Decreased living conditions in rural areas and increased poverty.
- Reduced quality of life and social unrest.
- Increased population migration from rural to urban areas.

State Inventory of Past Events[48]

The Idaho Department of Water Resources reports that a meteorological drought (a period of low precipitation) existed in the state during one-third of the period 1931-1982. Principal droughts in Idaho, indicated by stream flow records, occurred during 1929-41, 1944-45, 1959-61, 1977, and 1987-92. State-declared drought Disasters, representing events with significant economic and human impact, are listed in Table 15; only one, 1977, was Federally-declared.

Table 15 - Drought Disasters in Idaho, 1976-2000

Year	Federal	Counties Affected
1977	X	Adams, Bear Lake, Blaine, Camas, Caribou, Elmore, Idaho, Lincoln, Washington
1979		Blaine, Jerome, Lincoln, Minidoka, Oneida, Twin Falls
2000		Bear Lake

The most prolonged drought in Idaho was during the 1930s. For most of the State, the drought lasted for 11 years (1929-41) despite greater than average stream flows in 1932 and 1938. In northern Idaho, however, the drought was interrupted by greater than average stream flows from 1932 until 1937, but then resumed until 1946.

A mild drought during 1959-61 occurred in southern and central Idaho. During the early 1960's, several areas in the state also experienced water shortages.

[48] Material for this section from Idaho Department of Water Resources, 1997, and Idaho Department of Water Resources-Planning and Policy Division, 1995.

In 1977, the worst single year on record, a severe water shortage occurred throughout Idaho and the West. Area ski resorts were closed for much of the ski season. A lack of winter snowfall resulted in the lowest runoff of record at most gages in the state. Irrigation ditches were closed well before the end of the growing season and crop yields were below normal. Domestic wells in the Big and Little Wood River basins became dry early in April 1977, and many shallow wells in six western Idaho counties became dry in June.

Stream flows were again generally below normal from 1979 to 1981.

From 1987 through 1992, water supplies were much below normal throughout the state. In southwestern and central Idaho, this six year drought was more severe than the 1930s drought. Low winter snowpacks and prolonged periods of greater than average temperatures resulted in unseasonable early snow melt, high water demands, and the lowest stream flows since 1977. In 1987, the water supply ranged from 10 to 50 percent below normal over many areas of the state.

Projected Occurrences

Idaho's arid climate predisposes it to periodic droughts. Some areas of the state, however, have a greater potential for drought than the others. IDWR reports that, based on analysis of historic stream flow records, Southwestern Idaho and the upper portions of the Snake River Plain appear to have the highest probability for persistent, severe stream flow deficits.

Hazard Mitigation

Policy Framework

Mitigation of droughts is established, generally, in the Idaho Disaster Preparedness Act of 1975 as amended (Idaho State Code Chapter 10, Title 46) and, more specifically, in the Governor's Executive Order, 2000-04. The Executive Order also assigns the following responsibilities:

- Department of Agriculture—Primary support agency for mitigation activities pertaining to agricultural issues.
- Department of Commerce—Primary support agency for mitigation activities pertaining to economic injury/losses that result from disasters.
- Department of Water Resources—Develop mitigation programs for droughts in concert with the Bureau of Disaster Services.

The Idaho Drought Plan provides current and historic information, guidance and a framework for managing water shortage situations in Idaho. The information presented in this plan outlines and describes technical issues, and documents activities accomplished during recent water shortages. The Idaho Drought Plan is also designed as a resource and educational tool to be used when future water shortages occur.

The State Water Plan (prepared by the Idaho Water Resource Board with assistance from IDWR) establishes the state-wide water policy plan and component plans for individual basins or other geographic designations. These plans are reviewed and re-evaluated on a periodic basis.

Existing Mitigation & Mitigation Planning Programs

State

Drought-related resource management is intimately intertwined with general water supply management. Consequently, drought mitigation is to a large degree an extension of normal water management procedures.

The Idaho Department of Water Resources serves as the lead state agency in coordinating drought-related activities. IDWR has two major responsibilities related to droughts:

- Administration of all water rights.
- Inventory, monitoring, and planning of the state's water resources.

IDWR analyzes water supply data early in the water year to determine the probability of shortages. If a drought becomes likely, the interagency Water Supply Committee chaired by IDWR coordinates the State's drought-related activities. The committee, composed of State, Federal, private agency representatives, performs a number of tasks:

- Compiles drought-related data.
- Coordinates State agency actions.
- Provides public information.
- Promotes water and energy conservation.

At the end of the 1992 water year, the Idaho Water Resource Board offered financial assistance in the form of one-time cost share grants to assist regional entities in establishing winter cloud seeding projects. Projects were initiated in the Upper Snake, Bear and Boise River basins during the 1992-93 winter. Subsequently, the Legislature gave IDWR authority to coordinate weather modification projects designed to increase water supplies. The legislature also approved funding for IDWR to provide financial assistance to local or regional entities that are funding winter-season weather modification programs.

The Water Quality Division of the Department of Environmental Quality (DEQ) has oversight for the safety of drinking water, ground water protection, non-point and point source pollution, and municipal facilities construction. By maintaining the public water supply in good quality (effective maximizing the supply), shortages are mitigated. The Division contracts with the seven health districts for oversight of small community and non-community drinking water systems, addressing source protection and safe delivery for more than 2,080 community and non-community water systems state-wide. The Division also administers state and federal construction grants programs intended to provide financial assistance to Idaho communities needing new wastewater treatment systems or improvements to existing systems in order to protect public health and comply with water quality standards.

Federal

The Bureau of Reclamation (BOR) modifies its resource management and technical functions to reduce the adverse impacts of periodic water shortages. Drought mitigation is possible through four mechanisms:

- Project Sizing – projects are designed to limit the impact of water shortages.
- Water Conservation and Efficiency Improvement – conservation and efficiency measures are incorporated into new projects and retrofit into older projects; assistance is available to other agencies.
- Technical Assistance in Water Conservation Planning – Technical assistance is provided for the development and implementation of water conservation plans.
- Project (Dam) Operations. Projects are operated, to the extent feasible and permitted by law, to use the water resource in an efficient manner.

The Natural Resources Conservation Service (NRCS) monitors the snowpack in the western United States. This information is used to make volumetric stream flow forecasts for major rivers in the state (in conjunction with the National Weather Service). This early warning allows for water use adjustments and possible avoidance of a drought situation. The Water Resources Division of the U.S. Geological Survey (USGS) also collects, interprets, and disseminates hydrologic information.

Numerous Federal programs provide drought assistance.

Local

Cities, counties, and water or irrigation districts may undertake water conservation programs when confronted with likely droughts.

General Approaches to Mitigation

Hazard Management

Hazard management of droughts involves the long-term reduction of the probable gap between water supply and demand. Supply can

be addressed through the development of storage and delivery capacity (construction of reservoirs and associated facilities), improved operation of existing facilities, and weather modification. Demand can be addressed through various forms of conservation.

Weather modification is designed to increase the amounts of moisture realized from storms. Any weather modification program with the goal of increasing basin-wide winter snowpacks should be a multi-year commitment. Analyses indicate that a five to twenty percent seasonal precipitation increase can be achieved for climatic situations such as those in Idaho.

Water conservation efforts may include:

- Instituting conjunctive use of surface and ground water.
- Implementing water quality management and wastewater reuse.
- Reducing water conveyance losses.
- Reducing consumptive use by changing the type of water application system or instituting meter-based charging.

Information/Education

Drought-related educational efforts geared towards conservation both increase the effective water supply (by reducing demand) and build "drought resistance" by demonstrating how to withstand the effects of a prolonged drought. Drought-education materials should be designed to help residents and businesses learn methods of water conservation and instill these methods in their everyday lifestyles. Early information is vitally important to the agricultural community, allowing farmers make important seed ordering and planting decisions.

Regulatory

Conservation ordinances can be adopted by local jurisdictions (or voluntary measures may be adopted by water supply companies) to establish to constrain use to acceptable levels. Development regulations can be modified to encourage drought-resistant landscaping.

Mapping & Analysis

Early warning of drought conditions can be invaluable in establishing conservation programs to mitigate the impacts of the event. Ongoing monitoring of stream flow, ground water availability, and snowpack, and long-range weather forecasts are essential.

Recommended State-wide Hazard Mitigation Actions

Information/Education

SHMP-IE15	Coordinate Drought Information Efforts

Lightning

Hazard Assessment

Fundamentals

Thunderstorms are the most common experience of severe weather for residents of this country. The typical thunderstorm is fifteen miles in diameter and lasts an average of only thirty minutes. Despite their small size, thunderstorms can be very dangerous, producing lightning, flash floods, straight-line winds and tornadoes, and large hail. Approximately 10% of thunderstorms are classified as severe by the National Weather Service, meaning that they produce hail at least 3/4 inch in diameter, wind 58 mph or higher, or tornadoes.

Lightning is a spectacular phenomenon associated with all thunderstorms and is covered in detail here. Flash floods, winds and tornadoes, and hail are dealt with in other chapters.

The vigorous movement of air within a thunderstorm results in a buildup of electrical charge. This charge is released in a sudden discharge, the lightning "bolt" familiar to most. The discharge usually occurs within the clouds or between the clouds and the ground. The average discharge of lightning carries enough electricity to light a 100-watt light bulb for more than 3 months. Sound waves caused by the rapid heating and cooling of air near the lightning (a bolt of lightning reaches a temperature approaching 50,000 degrees Fahrenheit in a split second) are heard as thunder.

Lightning between cloud and ground is of obvious concern. The electrical charge and intense heat of lightning can electrocute, split trees, ignite fires, and cause electrical failures. The electrical discharge seeks the shortest route between cloud and ground and objects with high electrical conductivity. Natural "lightning rods" include tall, isolated trees in an open area or the top of a hill and metal objects such as wire fences, golf clubs and metal tools. Despite the widely held belief, lightning may strike twice in the same place and may strike several times in the same place during a single discharge.

Factors Contributing to Lightning

Three factors are necessary for the formation of thunderstorms:

- Moisture
- Unstable Air – relatively warm air that can rise rapidly
- Lift – advancing cold or warm fronts, strong breezes, or mountains

Thunderstorms typically follow a distinct lifecycle. In the Developing Stage, towering cumulus clouds form indicating rising air. The moist air mass is lifted by terrain features or atmospheric conditions and destabilized by rapidly circulating air currents. There is usually little to no rain during this stage and only occasionally lightning. In the Mature Stage, the storm may take on a black or dark green appearance. This is the most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes, and lasts an average of 10 to 20 minutes but may persist much longer. Finally, in the Dissipating Stage, rainfall decreases in intensity and bursts of strong winds may occur. Lightning remains a danger during this stage.

Thunderstorms may occur singly, in clusters or in lines. Thus, it is possible for several thunderstorms to affect one location in the course of a few hours. Some of the most severe weather occurs when a single thunderstorm affects one location for an extended time.

Thunderstorms are most likely to happen in the spring and summer months and during the afternoon and evening hours. They can, however, occur year-round and at all hours.

Lightning-Related Damages

Lightning may strike people or property through a number of forms:

- Direct Strike. The most dangerous; the person or structure is a direct path for lightning to seek ground.
- Side Strike. Similar to a direct strike, but lightning diverts to an alternate path from the initial ground point.
- Conducted Strike. The electrical current may be carried some distance from the initial ground point if the lightning strikes electrically conductive material (including electrical and electronic equipment).
- Other. The lightning strike may induce secondary discharges by altering the electrical potential between adjacent structures, through the earth's surface, or in electrical equipment.

Individuals struck by lightning are subject to severe injuries or death. Studies report that twenty percent of strike victims die and seventy percent of survivors suffer serious long-term after effects. Additional injuries not requiring hospitalization likely go unreported. Over ninety percent of incidents involve only a single victim and only one percent involves more than two victims.

Typical injuries include: external burns, numbness/parathesias, severe headaches, dizziness, stiffness in joints, loss of strength/weakness, hearing loss, muscle spasms, chronic fatigue, and coordination problems. Typical physiological injuries include: memory deficits and loss, depression, attention deficits, sleep disturbance, fear of crowds, and storm phobia.

The majority of lightning victims are children and young men engaged in recreation or work. Most lightning deaths and injuries occur when people are caught outdoors, most often in the summer months and during the afternoon and early evening. People under or near tall trees, in or on water, or on or near hill or mountain tops are particularly at risk.

Property damage resulting from lightning strikes includes mechanical impacts to trees and structures, ignition of flammable materials (natural and manmade), and disruption of electrical and electronic equipment. Forest fires are a common outcome in Idaho, as the lightning season coincides with the dry season.

While injuries typically occur in the afternoon and early evening, property damage frequently occurs into the late evening and night. Lightning does occur during these times, and property, unlike people who tend to avoid activities that place them at-risk at night-time (such as hiking, sports, and outdoor work), is immobile.

State Inventory of Past Events

Details on lightning events in Idaho are limited, but basic statistics are available. National Oceanographic and Atmospheric Agency (NOAA) maps divide Idaho into four bands, showing historic records of 10-19, 20-29, 30-39, 40-49 days of thunderstorms per year, respectively. The rate increases from the southwest portion of the state to the northeast, with the highest rates centered in the Lemhi Pass area. Lightning casualties and damages peak during the summer months.

Except in cases where significant forest or range fires are ignited, lightning generally does not result in disasters. For the period 1959-1994, NOAA reported twenty deaths, sixty-seven injuries, and 305 damage reports in Idaho. More recently, fatalities were reported in 1995 (three), 1996, and 1997. The extent of the damages is unknown and both injuries and damage are likely under-reported, possibly significantly.

Projected Occurrences

While Idaho experiences thousands of strikes annually, lighting poses a minimal hazard to most individuals. Communication, utilities, and most critical facilities with electronic equipment employ techniques to minimize the impact on their operation.

The general weather patterns of the last several decades are expected to continue. This will result in a maintenance of spring and summer, afternoon and evening occurrence of lightning through Idaho. Historical rates of injury are also expected to continue. The increasing dependence on electronic equipment and its utilization in all aspects of life may lead to an increase in the amount and extent of property damage resulting from lightning strikes.

Hazard Mitigation

Policy Framework

Mitigation of lightning is established, generally, in the Idaho Disaster Preparedness Act of 1975 as amended (Idaho State Code Chapter 10, Title 46) and, more specifically, in the Governor's Executive Order, 2000-04. No agency is specifically assigned responsibility for lightning-related mitigation, but the Bureau of Disaster Services is assigned general responsibility for mitigation coordination for all hazards.

Existing Mitigation & Mitigation Planning Programs

No lightning-specific mitigation programs currently exist within Idaho. Some education is conducted by land management agencies which provide educational materials for recreational users and the National Weather Service which provides general educational programs.

General Approaches to Mitigation

Hazard Management

Lightning hazard management involves both careful behavioral practices (e.g., avoiding golf courses during severe storms) and lightning-proofing businesses and residences. Electronic equipment in particular can be safeguarded through commonly available tools (e.g., grounded outlets and surge protectors).

Information/Education

Educational efforts can be directed at recreational users, workers, and other in the outdoors and home and property owners. Seasonal information campaigns can maximize the benefit from such efforts.

Infrastructure

Utility systems and other vulnerable infrastructures can be engineered to withstand lightning strikes.

Regulatory

Jurisdictions may adopt building safety codes such as NFPA-780 Standard for the Installation of Lightning Protection Systems (1997). Additional incentives may be provided by requiring the insurance industry to promote lightning-safe practices (e.g., rate reductions for installation and use of surge protectors).

Mapping & Analysis

Identification of high-risk areas through analysis of terrain, weather, and water features can help sensitive activities and business locate appropriately.

Recommended State-wide Hazard Mitigation Actions

Hazard Management

SHMP-HM16	Implement Electrical Protective Measures and Backup Systems for State Agencies

Information/Education

SHMP-IE13	Develop and Implement Coordinated Lightning Educational Activities

Severe Storms

Hazard Assessment

Fundamentals

Influenced by the Pacific Ocean, Idaho's moderate climate sees relatively few severe storms in comparison with the rest of the nation. Severe storms constitute the most common type of Presidential Disaster declaration in the United States, although only two storm-related Presidential Disaster declaration were made in Idaho during the period 1976-2000.

Damaging storms do occur, however, and casualties and extensive property damage (including impairment of economic activity) result throughout the state. Two types of severe storms are of concern in Idaho:

- Winter storms with accumulations of snow and ice, extreme cold, and reduced visibility.
- Thunderstorms with hail, lightning, and high winds.[49]

Winter Storms

Characteristics of Winter Storms

Winter storms range widely in size, duration, and intensity. These storms may impact a single community or a multi-state area. They may last hours or days. They may drop a small amount of dry snow or may blanket an area in wet snow and ice. Winter storms, though, are generally characterized by low temperatures and blowing snow.

A severe winter storm is defined as one that drops four or more inches of snow during a twelve hour period, or six or more inches during a twenty-four hour span. A blizzard is a winter storm with winds exceeding thirty-five miles per hour and temperatures of 20° F or lower. Strong winds can lower the effective temperature through "wind chill." An ice storm occurs when cold rain freezes immediately on contact with the ground, structures, and vegetation.

The principal hazards associated with severe winter storms are:

- Snow and/or ice accumulation.
- Extreme cold.
- Significant reduction of visibility.

Snow and/or Ice Accumulation. Heavy snow and/or ice can block roads, break power lines, topple trees, and lead to subsequent flooding and landsliding. Trapped motorists may be stranded for prolonged periods and may suffer injury or death if not prepared. Casualties may result as unfit residents attempt to dig out their homes and driveways; exhaustion or heart attack is the second most likely cause of winter storm-related deaths. Power outages can aggravate the extreme cold, leaving residents and livestock in the cold and dark for days.

Extreme Cold. The extreme cold during winter storms can lead to casualties both directly, through hypothermia, and indirectly. Hypothermia is a reduction of the body's core temperature due to prolonged exposure to cold. It is not always fatal but can produce long-term ill effects in survivors. Elderly are particularly at-risk. Frostbite, physical damage to bodily tissue from exposure to extreme cold, is a secondary risk that can also cause permanent damage.

Indirectly, extreme cold can lead to causalities through improper use of make-shift heaters (such as charcoal briquettes) in enclosed spaces. Many fuels produce carbon monoxide that can lead to asphyxiation and made cause structural fires if untended or out-of-control.

[49] Lightning and high winds are covered in separate chapters. General background on thunderstorms is covered in the lightning chapter.

Fire control may be hampered by freezing water supply and reduced accessibility.

Cold may persist long after the "storm" passes, complicating response and recovery functions.

Reduction of Visibility. Blowing snow and reduced sunlight during winter storms can make travel, both walking and driving, dangerous. Transportation accidents (automobile and other vehicle) are the leading cause of death during winter storms.

The impacts of a major storm may persist long after the event. Recovery may take months when extensive property and economic damage has occurred.

State Inventory of Past Events

Table 16 lists the State Disaster declarations that resulted from severe winter storms during the period 1976-2000. Two of these events, February 1996, and November 1996 - January 1997, were also Federal Disasters; these are detailed here.

Table 16 - Winter Storm Disasters, 1976-2000

Date	Counties Affected
January 1989	Bonner, Clark
January 1993	Jerome
January 1994	Elmore
February 1996	Benewah, Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Lewis, Nez Perce, Shoshone
November 1996 - January 1997	Adams, Benewah, Boise, Bonner, Boundary, Clearwater, Elmore, Gem, Idaho, Kootenai, Latah, Nez Perce, Owyhee, Payette, Shoshone, Valley, Washington

Northern Idaho, 1996.

The third week of January brought large amounts of low elevation snow, especially in the Panhandle region where stations measured an additional ten inches of snow. By the end of January, sites in the north had as much as two and one-half feet of snow on the ground.

During the last week of January, temperatures dropped below zero and highs remained in the single digits, causing ice to form on many rivers. Subsequent warming lead to extensive flooding throughout the region.

On February 11, 1996, the President declared a major disaster in the State of Idaho (designated *DR-1102*). Ten Counties and the Nez Perce Indian reservation were declared eligible for assistance. As of February 1, 2001, assistance included $22,635,325 in public assistance, $71,639 in individual assistance, $301,081 from the Natural Resource Conservation Service (NRCS), and $5,022,353 in hazard mitigation grants. Although much of this damage derived from flooding, the preceding storm clearly contributed to the disaster.

Northern Idaho, November 1996 – January 1997 In the last months of 1996, significant early season storms caused extensive damage and subsequently lead to severe landsliding and flooding throughout Northern Idaho. By many measures this was a significant series of storms. Mountain snowpacks were holding more than 150% of normal water content. Snowfall in areas of the Panhandle counties sometimes exceeded the design loads of buildings.

During the period of November 16-21, two to three feet of snow was dumped in the Bonners Ferry area, collapsing roofs of businesses, schools, and homes. On November 19, freezing rain produced one inch of ice in Kootenai, Clearwater, and Idaho counties. Strong winds aided the ice in toppling numerous trees and power lines. Power outages lasted for weeks. Additional above-normal snowfall fell in late December, throughout Northern and Central Idaho. Subsequent warm rains produced heavy runoff that overwhelmed rivers and led to flooding and widespread landslides.

On January 4, 1997, the President declared a major disaster (designated as *DR-1154*). Eighteen counties were declared eligible for Federal assistance. As of February 1, 2001, assistance included $19,404,105 in public assistance, $39,988 in individual assistance, $125,937 from the NRCS, $576,314 from the Army Corps of Engineers, and $5,593,892 in hazard mitigation grants.

Projected Occurrences

The occurrence of severe winter storms is to a large part dependent on broad climatic trends. These trends are difficult to forecast and the assumptions underlying projection of future vents are subject to intense debate. The relative high frequency of these events in the 1990s may reflect a change in the overall pattern or it may be only a minor deviation from the norm.

It is consequently difficult to generate any hard estimates of future storm frequency or intensity. It is reasonable to suspect, however, that the relatively moderate climate of Idaho will continue to limit the number and severity of winter storms within historic ranges.

Although past disasters have been focused in the western and northern portions of the state, severe winter storms are possible through Idaho. All of the state is rated as "Moderate Snowfall" or "Heavy Snowfall" by FEMA.[50] As population growth and development continues through the state, the possibility of significant damage also increases.

Hail

Characteristics of Hail

Hail is a product of thunderstorms and their dynamic internal winds. Air cycles vertical through the storm mass, known as a "cell." At the earth's surface, air is warmed and rises through the cell. As it reaches the higher atmosphere (cells can rise ten of thousands of feet above the surface), it cools and drops back to the surface, replacing warm air rising from the base of the cell. This ongoing cycle captures and carries water droplets up to a height where freezing occurs. The resultant ice particles grow on each cycle up and down within the storm cell, until, too heavy to be carried by the rising air, they fall to the ground as hail.

Hail is produced in a wide range of size and falls in varied quantities. Hail of ¾ inch or greater diameter is sufficient to classify a thunderstorm as "severe."

Hail is capable of great damage. Falling at high speeds from extreme heights, large hail can strike with great force. Vegetation (including crops) and automobiles are commonly damaged during severe storms; there is nearly one billion dollars in damage to property and crops annually across the nation. Property stored outside (such as automobiles at sales lots) is particularly at-risk and may result in extensive economic damages. Structures and livestock may also be at risk.

State Inventory of Past Events

Hail falls in various locations throughout the state every year. Significant events are most common in summer. For example, in June 1996, golf-ball sized hail was reported in Bonneville County. During the same storm large hail damaged vehicles east of Newdale in Madison County.

No State or Federal Disaster declarations have resulted from hail damage.

Projected Occurrences

Hail damage can be expected to continue at historic levels. Thunderstorms are most likely to happen in the spring and summer months and during the afternoon and evening hours. They can, however, occur year-round and at all hours.

Hazard Mitigation

Policy Framework

Mitigation of severe storms hazards is established, generally, in the Idaho Disaster Preparedness Act of 1975 as amended (Idaho State Code Chapter 10, Title 46) and, more

[50] Federal Emergency Management Agency, 1993 (a).

specifically, in the Governor's Executive Order, 2000-04. No agency is specifically assigned responsibility for storm-related mitigation, but the Bureau of Disaster Services is assigned general responsibility for mitigation coordination for all hazards.

Existing Mitigation & Mitigation Planning Programs

Building codes, where adopted, typically contain provisions for resisting anticipated snow loads. There are no other existing severe storm specific mitigation programs in Idaho.

General Approaches to Mitigation

Hazard Management

Structures in winter storm hazard areas should be designed and built to withstand the projected snow (and ice) loads. Non-occupancy buildings, such as greenhouses and storage sheds, which are not subject to building codes should be given special attention. High-cost or difficult-to-replace property should not be stored outside in high-risk areas.

Critical facilities in high storm hazard areas should be designed and managed to withstand likely storm impacts such as power outages, personnel shortages, and property damage.

Information/Education

Residents and property owners should be informed of storm hazards and educated in safety and mitigation techniques.

Infrastructure

Snow fencing and related technologies should be constructed in areas where important highways are at-risk of blockage during storm events. Utility lines should be placed underground where feasible. Above-ground utility lines should be kept free of potentially damaging vegetation.

Regulatory

Adoption and enforcement of appropriate building codes and construction standards can significantly reduce damages caused by severe storms.

Mapping & Analysis

As with all hazards, an accurate understanding of the hazard is the first step towards mitigation.

Recommended State-wide Hazard Mitigation Actions

Hazard Management

SHMP-HM17	Design State Facilities for Storm-resistance
SHMP-HM18	Inspect Schools and Other Public Buildings for Snow-load Resistance and Retrofit as Necessary

Information/Education

SHMP-IE17	Conduct Storm-Resistant Building Design Training for Building Officials and Inspectors
SHMP-IE18	Conduct Storm-resistant Building Materials and Techniques Training

Infrastructure

SHMP-IS06	Maintain Vegetation Clearance in Utility Rights-of-Way
SHMP-IS07	Retrofit Utility Lines to Isolate Failures
SHMP-IS08	Install Utility Lines Underground
SHMP-IS09	Install Snow Drifting Controls in Critical Areas

Regulatory

SHMP-RE06	Adopt State-wide Building Safety Codes

Mapping & Analysis

SHMP-MA09	Develop a State-wide Snow Load Hazard Zone Map

Volcanic Eruptions

Hazard Assessment

Fundamentals

Idaho is subject to hazards from volcanic eruptions both within the state and from surrounding states. Volcanic eruption is generally not a major concern in Idaho due to the relatively low probability (compared with other hazards) of events in any given year. Additionally, the most likely event, a volcanic eruption in the Cascade Mountains, is expected to only produce moderate impacts in the state.

The potential for severe damages resulting from a major event is real, however. The geologic history of Idaho and the region has a significant component of volcanic activity. Consequently, the State is well advised to undertake mitigation planning.

Given the low probability and unique nature of these events, volcanic eruptions pose a special problem for emergency management personnel. Some special characteristics that influence emergency response and mitigation include:

- Eruptions generally have many precursors but these potentials warnings are often ambiguous; i.e., we can often forecast activity generally but rarely precisely.
- There is a large range in the magnitude/frequency relation for eruptions; i.e., there is no way to easily anticipate the scale of the impending eruption.
- The scale of eruptions may far surpass any other hazard.
- Some of the hazards associated with an eruption can be fast moving.
- The impacts from volcanic eruptions can be very long lasting – centuries or more.
- Volcanic eruptions are outside of most people's realm of experience and consequently the public has a minimal appreciation of the hazards.

Characteristics of Volcanic Activity

Volcanic activity within the state has been generally related to the Yellowstone "hot spot," a plume of magma (molten rock) beneath the earth's surface. This abnormality allows magma to rise to and through the crust from deep within the earth. Volcanic activity results when the magma reaches the surface through "vents." Magma cools as it reaches the surface, forming the rocks that comprise volcanoes and other volcanic features.

Volcanic activity related to the hot spot varies over time. Initially, lava (the term for magma that has reached the surface) is thick and sluggish. This lava (rhyolitic lava) often forms bulbous, unstable "lava domes" where it is extruded to the surface. This period is also marked by violent eruptions that produce caldera (large craters) up to thirty miles in diameter.

Over time, a more fluid form of lava rises to the surface. This fluid lava (basaltic lava) often forms fast-moving streams that can spread out in thin broad sheets up to several miles wide. These surface flows are characteristic of much of the Snake River Plain.

Volcanic activity in the Cascade Mountains is a product of plate tectonics, the motion of the large masses (plates) that comprise the earth's surface. Many of the world's earthquakes result from forces along the margins of these tectonic plates. The tectonic plates are constantly in motion relative to each other, either pulling apart or pushing together. In the Cascade region, one plate is forced under another, 50-100 miles west of the current shoreline, stretching from Vancouver Island to northern California. When the crust material reaches sufficient depth, it is re-melted and rises to the surface as magma. As with Idaho's hotspot,

volcanic activity results when the magma reaches the surface through vents.

There are two types of volcanoes in the Cascades — composite and mafic. Composite volcanoes are typically steep-sided and symmetrical, built of alternating layers of lava flows, volcanic ash, and other eruptive materials. They may build large cones and may erupt explosively; activity can last tens to hundreds of thousand of years. Mafic volcanoes are generally active for a shorter time (weeks to perhaps centuries), after which activity shifts to new vents in the area. Mafic volcanoes are typically smaller and less prone to violent eruptions than composite volcanoes. Composite volcanoes are the most likely to impact Idaho.

Volcanic Hazards and Related Damages

Volcanic hazards may be divided into two categories based on the range of their impact from the eruptive center or active vent. Proximal hazards are those whose impacts are limited to a distance of thirty miles or less from the active vent. Distal hazards are those whose impacts may be felt far beyond the active vent.

Not all volcanic activity will result in all of the hazards listed here. The nature of the lava (rhyolitic or basaltic), the history of the current and past eruptions at the site, the presence of ground water, and other factors influence the size, character, and duration of the eruption and the resultant hazards.

Proximal Hazards

Lava Flows. Lava flows are pouring or oozing collections of lava extruded from vents. These flows can destroy all structures in their paths and start forest fires, but they advance relatively slowly so they seldom endanger people. Lava flows do damage or totally destroy everything in their paths by burying, crushing, or burning. Large areas of productive and/or developable lands may be lost to lava flows. They can also generate additional hazards by damming or diverting streams.

Pyroclastic Flows. Pyroclastic flows are avalanches of hot ash, rock fragments, and gas that move down the sides of a volcano during explosive eruptions or lava dome collapses. These pyroclastic flows can be as hot as 1,500°F and move at speeds of up to 100 to 150 miles per hour. They are capable of knocking down and incinerating everything in their paths. Such flows tend to follow valleys and are generally restricted to the immediate vicinity of the volcano. Lower-density pyroclastic flows, called pyroclastic surges, can easily overflow ridges hundreds of feet high.

Lahars and Debris Avalanches. Lahars are mud or debris flows, composed mostly of eruptive materials, on the flanks of a volcano. These flows can travel at speeds of 20 to 40 miles per hour and cover long distances. Historically, lahars have been one of the deadliest volcano hazards. Debris avalanches are rapid downhill movements of rock, snow, and/or ice. They range from small movements of loose debris on the surface of a volcano to massive collapses of the entire summit or side of a volcano. Debris avalanches on volcano slopes are triggered when eruptions, heavy rainfall, or large earthquakes cause these materials to break free and move downhill.

Volcanic Gases. Volcanoes emit a number of potentially toxic gases, both during and in between eruptions. The majority of the gas is water vapor (steam), derived from recent precipitation and ground water. Other common volcanic gases include carbon dioxide, sulfur dioxide, hydrogen sulfide, hydrogen, and fluorine. Sulfur dioxide gas reacts with atmospheric water to create acid rain, causing corrosion and harming vegetation. Carbon dioxide is heavier than air and can be trapped in low areas in concentrations that are deadly to people and animals. Fluorine can be absorbed onto volcanic ash particles that later fall to the ground, poisoning livestock grazing on ash coated grass and also contaminating domestic water supplies.

Tephra. An explosive eruption blasts tephra (solid and molten rock fragments) and gases into the air with tremendous force. The rock fragments range in size from large “bombs”

(fist-sized up to three feet or more in diameter) to fine dust. The largest rock fragments usually fall back to the ground within two miles of the vent. Tephra deposits can pose a risk to lives and structures if they accumulate in a thickness sufficient to collapse roofs. More commonly, they reduce visibility and clog vehicle air filters, posing a hazard on highways. Deposits can topple or short-circuit electric transformers and power lines and clog other infrastructure (such as water and sewage treatment facilities). Tephra clouds also commonly generate lightning that can interfere with electrical and communication systems and start fires. Fine material is extremely slippery, hampering driving and walking and can damage the lungs of small infants, elderly, and those having respiratory problems.

Distal Hazards

Eruption Columns and Clouds. Small fragments (less than about 0.1 inch across) of volcanic glass, minerals, and rock released during explosive eruptions rise high into the air, forming an eruption column. Eruption columns can grow rapidly and reach more than 12 miles above a volcano, forming an eruption cloud. Large eruption clouds can extend hundreds of miles downwind, resulting in ash fall over enormous areas; the wind carries the smallest ash particles the farthest. The volcanic ash in the cloud can pose a serious hazard to aviation; engines of jet aircraft have suddenly failed after flying through clouds of even thinly dispersed material.

Ashfall. As the cloud drifts downwind from the erupting volcano, the material that falls from the cloud typically becomes smaller in size and forms a thinner layer. Though called "ash," volcanic ash is not the product of combustion, like the soft fluffy material created by burning wood, leaves, or paper. Volcanic ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. Damages from ashfall are similar to those from tephra (ash being a form of tephra). Communities far from the actual eruption may be seriously disrupted by ashfall; recovery is dependent on the deposition amount, but may take weeks.

State Inventory of Past Events

The only significant volcanic event in Idaho during recorded history was ashfall from the eruption of Mount St. Helens in 1980 (detailed below). Idaho has seen extensive volcanic activity in the more distant past, however.

The Snake River Plain is at least partially a product of volcanic activity. The Craters of the Moon National Monument area saw extensive basaltic lava flows up to 2000 years ago. The Boise area experienced large lava flows one million years ago.

The Yellowstone area has been impacted by volcanic activity throughout the last two million years. Major explosive eruptions occurred two, 1.3, and 0.6 million years ago. The youngest caldera is very large - approximately fifty miles by thirty miles. The most recent eruptions, 75,000-150,000 years ago, produced thick lava flows.

The Gem Valley area in southeastern Idaho has also been volcanically active; the last eruptive activity occurred about 30,000 years ago.

Other portions of Idaho have experienced significant ashfall from past Cascadian and Yellowstone eruptions.

Mount St. Helens

On May 18, 1980, Mount St. Helens, Washington, erupted, killing fifty-seven and causing over one billion dollars of damage in the Northwest. The eruption followed two months of earthquakes and minor eruptions, and this warning allowed most people in the proximal hazard area to evacuate prior to the eruption.

Ashfall from the 1980 eruption of Mount St. Helens impacted northern Idaho, covering roads, affecting crops, machinery and vehicles, and creating health issues. The damage resulted in a Presidential disaster declaration that included Benewah, Bonner, Boundary, Clearwater, Kootenai, Latah, and Nez Perce counties.

Projected Occurrences

Unlike many other hazards, volcanic eruptions generally occur only after significant warning. Volcano monitoring can detect and measure changes caused by magma movement beneath the volcano. This movement will typically lead to:

- Swarms of earthquakes.
- Swelling or subsidence of a volcano's summit or flanks.
- Release of volcanic gases from the ground and vents.

Monitoring can consequently be useful for projecting volcanic activity within a time frame of days to months. Longer-term hazard projection is more difficult and is generally dependent on analysis of past activity.

Idaho faces two likely future volcanic hazard scenarios:

- Proximal and distal hazards from volcanic activity within or adjacent to the state (primarily from the Snake River Plain and Yellowstone areas).
- Distal hazards from volcanic activity in the Cascades.

Projected Idaho Events

Yellowstone Volcano. The hydro-thermal features of the Yellowstone National Park area are fueled by the large magma plume (the "hotspot") that lies below the region. These features are volcanic activity, although not of a generally hazardous nature. The high levels of seismic activity and active deformation of the surface in the area also indicate the high volcanic potential of Yellowstone. Past eruptions suggest that the potential for extensive and catastrophic eruptive activity is possible.

Snake River Plain. Most past volcanic activity in the Snake River Plain was confined to "volcanic rift zones," linear areas of cracks in the earth's crust. Principal amongst these is the Great Rift, a volcanic rift zone running roughly northwest to southeast across almost the entire eastern part of the Snake River Plain. Volcanic activity in this area has been characterized by eruptions of basaltic lavas resulting in extensive lava flows. These flows resulted from eight distinct eruptive periods with an average recurrence interval of 2,000 years. As the most recent flows in the area occurred approximately 2,000 years ago, extrapolation suggests that activity may resume in the not too distant future. There has been no recent evidence of current activity, though.

Cascades

Ten volcanoes (or volcanic centers) within the Cascade Mountains have been active within the last two thousand years.[51] An additional four are regard as potentially active.[52] As the eruption of Mount St. Helens demonstrated in 1980, activity in this region can have significant impact over a wide area, including Idaho. According to the U.S. Geological Survey (USGS), portions of Idaho have a 1:1,000-1:5,000 annual probability of receiving one centimeter or more of ashfall from any major Cascade volcano; there is a less than 1:10,000 probability of ten centimeters or more. Appendix N contains more details on the eruptive history and status of the Cascade volcanoes.

Hazard Mitigation

Policy Framework

Mitigation of volcanic hazards is established, generally, in the Idaho Disaster Preparedness Act of 1975 as amended (Idaho State Code Chapter 10, Title 46) and, more specifically, in the Governor's Executive Order, 2000-04. The Executive Order assigns primary responsibility for formulating and directing the state's geologic hazard reduction effort to the Idaho Geologic Survey. Duties include hazard identification, analysis and mapping of the geologic threats, and provision of representatives for hazard mitigation teams. The Executive Order also assigns the Idaho Transportation

[51] Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens, Mount Hood, Three Sisters, Newberry Crater, Mount Shasta, Medicine Lake, and Lassen Peak.
[52] Mount Adams, Mount Jefferson, Crater Lake, and Clear Lake.

Department responsibility for providing engineering support to State mitigation activities related to volcanic eruptions.[53]

Existing Mitigation & Mitigation Planning Programs

Currently, there are no active volcano-specific mitigation programs within Idaho. Research and monitoring of hazards does occur though.

The USGS Volcano Hazards Program monitors the volcanic regions of the United States, including the Pacific Coast States, Wyoming, Hawaii, Alaska, and the Yellowstone area. As an element of this program, the USGS, Yellowstone National Park, and University of Utah entered into an agreement in 2001, to establish the Yellowstone Volcano Observatory. This partnership provides for the study and monitoring of active geologic processes and hazards of the Yellowstone Plateau volcanic field and its caldera.

A similar facility, the Cascades Volcano Observatory (CVO), has been operating near Mount St. Helens since the 1980s. CVO was able to issue accurate warnings of the small eruptions that occurred at Mount St. Helens through 1986. Research also allows assessments of long-term hazards. Additionally, regional seismic network, the Pacific Northwest Seismograph Network, operated jointly by the Geophysics Program at the University of Washington and U.S. Geological Survey, is used to monitor seismic activity in the Cascades. A significant increase in seismicity may occur prior to volcanic eruptions.

General Approaches to Mitigation

Hazard Management

As eruptive activity rarely comes without significant warning, mitigation efforts in likely proximal hazard zones should ensure that development avoids siting critical or high-investment development in high-risk areas. This will reduce the overall disaster cost if an event does occur without unnecessarily constraining land use.

Information/Education

Due to the infrequent nature of volcanic activity in the state, the public's appreciation of the hazards is limited. Information regarding distal hazards should be made available to citizens and property owners through the state. Information on proximal hazards should be prepared so that it may be readily available if an event does become likely.

Infrastructure

Infrastructure should not be sited in probable proximal hazard zones if feasible alternatives exist.

Regulatory

Building codes should ensure that new development can withstand probable ashfall loads. Land use regulations can mandate siting considerations discussed under *Hazard Management*.

Mapping & Analysis

Accurate mapping of volcanic hazards is the first step in mitigation. Thorough analysis, however, may need to wait until precursors of volcanic activity grow more apparent or are better understood.

[53] Governor's Executive Order, 2000-04.

Recommended State-wide Hazard Mitigation Actions

Hazard Management

SHMP-HM20	Require Consideration of Proximal Volcanic Hazards in Siting of State Facilities

Information/Education

SHMP-IE25	Develop and Disseminate Information on Volcanic Hazards

Infrastructure

SHMP-IS10	Require Consideration of Proximal Volcanic Hazards in Siting of State Infrastructure

Wind/Tornadoes

Hazard Assessment

Fundamentals

Two types of significant wind hazards are possible in Idaho, straight-line winds and tornadoes. Both are generally associated with severe thunderstorms.[54]

Lesser, similar wind events (such as "dust devils") may occur during small storms and even during clear weather but generally do no damage. Strong winds are also often associated with dramatic atmospheric pressure differentials across weather fronts. These winds may be accelerated by terrain features such as canyons and mountain passes and reach high speeds. Although they may contribute to the overall impact of a storm, they are rarely damaging in themselves.

The term "straight-line winds" is used to distinguish common, non-rotating winds from tornado-related winds. Straight-line winds are responsible for most thunderstorm wind damage, with wind speeds in excess of 100 miles per hour on occasion. A "downburst," a small area of rapidly descending air beneath a thunderstorm, is a particularly damaging type of straight-line wind. Downbursts can have wind velocities equal to that of a strong tornado and can be extremely dangerous to aviation and cause significant damage to some buildings.

A tornado is a violently rotating column (a vortex) of air that bridges between thunderclouds and the earth. A funnel-shaped cloud, spinning like a top, is commonly generated. Wind speeds within the vortex range from forty miles per hour to over three hundred miles per hour. The tornado itself can move across the ground at up to seventy miles per hour. Damage is generally confined to a narrow path (approximately one quarter mile) but the tornado may travel over, and devastate, a large distance (typically up to ten miles but two hundred mile tracks have been reported).[55] Multiple tornadoes may occur during a single storm resulting in highly destructive events.

Tornado intensity is measured on the Fujita Scale, Table 17. This table also describes characteristic damages.

State Inventory of Past Events

Tornadoes are uncommon in Idaho but they do occur. The National Oceanographic and Atmospheric Administration (NOAA) recorded sixty-four tornadoes between 1959 and 1988; all were F3 or less, and no deaths were reported.

On June 11, 1993, a tornado traveled ten miles south to southeast of Pocatello, ending in the town of Inkom. The tornado uprooted several trees, knocked down a grain elevator, overturned a truck, and knocked down several outbuildings. This event resulted in a State Disaster declaration for Bannock County.

In April 1995, a series of tornadoes touched down in central Bingham County causing damage to mobile homes, highway signs, and recreational equipment.

Significant straight-line wind events have been recorded in the Lowman area (large-scale forest damage in the 1970s) and Payette and Weiser area (in the 1990s). No State or Federal Disasters have been declared for wind related events in Idaho.

[54] General background on thunderstorms in covered in the Lightning chapter.

[55] University Of Idaho Cooperative Extension Service, n.d.

Table 17 - Tornado Intensity		
Level	**Wind Speed**	**Description**
F0	40-72 mph	Damage to chimneys, branches broken off
F1	73-112 mph	Surface peeled off roof, mobile homes pushed off foundations or overturned
F2	113-157 mph	Roofs torn off frame houses, mobile homes demolished, trees snapped or uprooted
F3	158-206 mph	Roof and some walls torn off, most trees uprooted, heavy cars lifted off ground
F4	207-260 mph	Well-constructed houses leveled, cars thrown and large missiles generated
F5	261-318 mph	Strong frame houses carried considerable distance, steel reinforced structures badly damaged
F6	319+ mph	Very unlikely

Projected Occurrences

Based on past events, tornadoes can be expected to occur infrequently, averaging two to three events per year. Most Idaho tornadoes have winds less than 113 miles an hour – making them "moderate". A few have had winds up to 130 miles an hour – "significant".

Tornadoes in Idaho have usually occurred from March to October, with the majority occurring in June. The majority also occurs during the afternoon, between 12:00 and 6:00 p.m. Tornadoes are most often reported in the Magic and Upper Snake River valleys.

Hazard Mitigation

Policy Framework

Mitigation of windstorm and tornado hazards is established, generally, in the Idaho Disaster Preparedness Act of 1975 as amended (Idaho State Code Chapter 10, Title 46) and, more specifically, in the Governor's Executive Order, 2000-04. No agency is specifically assigned responsibility for lightning-related mitigation, but the Bureau of Disaster Services is assigned general responsibility for mitigation coordination for all hazards.

Existing Mitigation & Mitigation Planning Programs

Building codes, where adopted, typically contain provisions for resisting anticipated wind loads. There are no other existing windstorm or tornado specific mitigation programs in Idaho.

General Approaches to Mitigation

Hazard Management

Structures in wind-hazard areas should be designed and built to withstand the projected wind speeds. Wind-resistant construction techniques include proper anchoring of walls to foundations, use of hurricane straps and clips to hold the roof of a structure to its walls, and lateral roof and wall bracing. Manufactured and mobile homes in particular need anchoring. Structural retrofitting of existing structures can reduce damages; particular concern should be given to the roof, windows, doors, and anchoring to the ground or foundation. In very high hazard areas, hardened "safe roofs" can be constructed for shelter during events.

Non-structural retrofitting can also be effective at reducing damages (and will also be effective at mitigating seismic hazards). Examples of non-structural retrofitting include anchoring loose objects (potential missiles) and water heaters, removing trees from the immediate vicinity of the house, securely anchoring

outbuildings and other outdoor objects, and installing plastic film on windows and doors to minimize the impact of shattering glass.

Information/Education

In areas that have not seen recent wind events, the hazard may be seriously undervalued. Many residents and property owners may be unaware that their lives and properties lie in high-risk areas. Residents and property owners should be informed of known wind hazards and educated in mitigation techniques. Manufactured and mobile homes is high-risk areas should be specifically targeted by education efforts.

Infrastructure

Wind-susceptible critical facilities should not be placed in high wind hazard areas.

Regulatory

Adoption and enforcement of wind-resistant building codes and construction standards can significantly reduce damages caused by high winds. Manufactured and mobile homes should be restricted, or sufficient anchoring be required, in very high risk areas.

Mapping & Analysis

As with all hazards, an accurate understanding of the hazard is the first step towards mitigation.

Recommended State-wide Hazard Mitigation Actions

Information/Education

SHMP-IE16	Develop and Implement Coordinated Wind Hazard Educational Activities

Regulatory

SHMP-RE06	Adopt State-wide Building Safety Codes
SHMP-RE10	Mandate Tie-downs for Non-permanent Manufactured and Mobile Homes

Chapter 6 - RECOMMENDED MITIGATION ACTIONS

HAZARD MANAGEMENT

Strategy	SHMP-HM01: Develop and Implement Methods for the Identification and Disposal of Non-hazardous Waste Transported by Flooding
Actions	Research and develop techniques for the identification and disposal of non-hazardous, non-putricible solid waste, dead/unclaimed animals and household hazardous waste. Disseminate these procedures to all government agencies and the public sector.
Background	Flooding in both urban and rural areas can result in the transportation and haphazard deposition of a variety of household, industrial, agricultural, and other wastes. Although such wastes do not fall under the classification of "hazardous materials" they do pose health and safety concerns and should be removed from the flooded area at the earliest possible opportunity.
Implementation	State
Status	

Strategy	SHMP-HM02: Address Heavy Metal Contamination Problems through Identification, Containment, and Cleanup
Actions	Aggressively address the Coeur d'Alene contamination problem: • Assess contaminated materials to determine methods that are appropriate to lower the risks of these materials entering the water. Evaluate, develop and implement appropriate methods to reduce the risk and impact, including removal and in situ stabilization. • Site and construct mine waste repositories for the disposal of excavated contaminated materials that are located outside of the Coeur d'Alene Superfund site boundary. • Develop/encourage a program to enable voluntary clean up of heavy metal contaminated sites including handling guidelines and disposal options. • Support continuing efforts by private sector and government agencies within the Coeur d'Alene Basin to aggressively address the remediation of

	high priority mine related sites. Priority of the sites is based on the potential for heavy metal leaching into water bodies. Inventory other mining districts in the State and evaluate for potential contamination. Work with the districts to develop containment and cleanup programs where appropriate. Where current or past mining operations may have placed potentially hazardous materials in the floodplain, implement a program to: • Assess contaminated materials to determine methods that are appropriate to lower the risks of these materials entering the water. Evaluate, develop and implement appropriate methods to reduce the risk and impact. This may include removal and in situ stabilization. • Site and construct mine waste repositories for the disposal of excavated contaminated materials. Develop/encourage a program to enable voluntary clean up of heavy metal contaminated sites including handling guidelines and disposal options.
Background	Heavy metals from mine waste and contaminated sediments have been documented being re-suspended and transported down the Coeur d'Alene River system. This material is being deposited on the floodplain, in slow moving reaches of the river and in the lake. This contamination poses a risk to human and animal health and the environment. Similar contamination may exist in other areas of the state with a mining history. The true extent of the potential problem is unknown.
Implementation	State (DEQ)
Status	In Progress

Strategy	SHMP-HM03: Clear and Maintain Stream Channels
Actions	Coordinate a program to assist stream clearance and maintenance by local agencies and private individuals and companies. This effort will: • Expand landowner and agency awareness of Best Management Practices (generally accepted, state-of-the-art techniques) for implementing agricultural, mining and forest practices for maintaining stream clearance compatible with fish and wildlife habitat. These Best Management Practices should establish seasonal “work windows” in sensitive fish habitat areas. • Fund additional inspectors at Idaho Department of Lands for forest land and at Idaho Department of Water Resources for non-forest land. Restrict the movement or removal in-channel debris to cases where it poses a significant threat. Relocation of debris to "safe" locations within the channel to maintain fish habitat is preferred over complete removal. Establish stream debris removal and emergency maintenance procedure agreements between State agencies and the counties.
Background	The severity of a flood event may be increased when downed trees, sediment deposits, and other debris in stream and river channels restrict the flow of water. Such ponding can result in significant out-of-channel inundation and levee overtopping. Bridges, openings and culverts must be periodically inspected and rou-

	tinely cleaned prior to, during, and after high water events. Additionally, debris jams may be formed when downed trees, sediment deposits, and other debris collect in stream and river channels. When these debris jams break and restrained waters are released suddenly, flash flooding may result. Debris removal should balance flood control needs and other stream functions. Naturally occurring debris provides for fish habitat and stream stabilization and should not be removed when it does not result in excessive constriction at bridge or culvert openings. Coordination among agencies with stream management and flood control duties is necessary to effectively address these issues.
Implementation	State (Soil Conservation Districts); NRCS
Status	

Strategy	SHMP-HM04: Control Upstream Sediment and Debris Sources
Actions	Address road-related sediment and debris by: • Implementing watershed restoration programs which will eliminate roads at high risk of failure and/or no longer needed for the forest transportation system. • Encouraging landowners to stabilize abandoned roads and remove unnecessary and non-functioning culverts.
Background	The impact of sediment and debris (i.e., channel constriction during high water) may be lessened when their upstream sources are identified and treated. Generally, the greatest source of sediment in the forested watershed is from roads and landslides.
Implementation	State
Status	

Strategy	SHMP-HM05: Stabilize Disturbed Reaches to Control Sediment
Actions	Develop and implement a program for the stabilization of disturbed reaches. This action will address the destabilizing influence of bulldozing, re-channeling, and other development impacts, and their effects on downstream sedimentation. The program will identify unstable stream channels and pursue appropriate projects including: • Stream channel rehabilitation that stabilizes the channel, maximizes floodplain function, and maintains or restores beneficial uses including fisheries habitat. • Placement of sediment bedload traps maintained to function during high flow events. • Headwater and watershed restoration projects to ensure success of downstream projects. • Alluvial fan and floodplain restoration and stabilization projects.

Background	The impact of sediment and debris (i.e., channel constriction during high water) may be lessened when their upstream sources are identified and treated. Highly unstable channels in disturbed reaches (e.g., where extensive bulldozing or channelization has occurred) can contribute significant sediment and debris.
Implementation	State
Status	

Strategy	SHMP-HM06: Develop a State-wide Levee Safety Program and Levee Task Force
Actions	Develop a comprehensive state-wide levee safety program: • Evaluate levee maintenance and management throughout the state with the assistance of the US Army Corps of Engineers. • Implement an emergency maintenance and management program for levees where health and safety concerns are identified. • Develop partnerships between dike districts and counties and the US Army Corps of Engineers for rehabilitation and maintenance of selected dikes. • Promote setback levee designs and alternative technologies (e.g. replacing levees with floodplain easements) for rehabilitation and new construction projects. Establish a State Levee Task Force, under the direction of the Governor and composed of appropriate agency representatives and technical advisors, to address long-term levee issues, including: • Ownership of levees (including non-Federal levees). • Maintenance of levees and alternatives to repair where practicable. • Reconstruction of levees. • Utility of some levees. • Stream channel maintenance. • Technical advice on levee management. • Assistance in forming levee districts.
Background	Levees in Idaho range from carefully-engineered, regional projects to emergency response, "bulldozer dikes." Oversight and maintenance are also variable with the result being a wide range of levee quality and safety in the state. The principal danger from levees is overtopping and failure which can result in significant flooding in areas thought to be "safe." Overtopping is a true emergency situation that requires fast and effective response to avoid extensive damage. Levees and roads have usually been built adjacent to river channels and restrict floodwater access to the normal floodplain. This reduction of storage capacity may result in increased flood severity downstream and places the levees at in-

	creased risk. Alternatives such as setback levees and the use of floodplain easements to eliminate the need for levees require less ongoing oversight and maintenance.
Implementation	State
Status	

Strategy	SHMP-HM07: Establish a Flood Hazard Advisory Commission
Actions	Establish a State Flood Hazard Advisory Commission. Findings of the Commission will be implemented by all appropriate State agencies. Specific mandates of the Commission will include: • Evaluating the effectiveness of current State and other programs that address floodplain conservation and identifying possibilities for agency coordination. • Evaluating potential methods to conserve and increase the storage capacity of floodplains, especially in areas with extensive flooding history and/or extensive current or potential development. At a minimum, the Commission will consider: 1. Replacing existing levees with setback levees. 2. Acquiring easements to maintain floodplains in an undeveloped condition. 3. Acquiring and removing structures that do not comply with floodplain ordinances. 4. Acquiring floodplain areas and managing as public open space. 5. Routing flood waters to aquifer recharge sites. • Developing a state-wide watershed evaluation and rehabilitation program. Evaluation work will be performed by State agency staff; rehabilitation projects will take advantage of existing State and other programs and funding sources. This comprehensive, state-wide program will work in cooperation with other State sediment control and upland modification mitigation programs which target specific critical needs and are working in shorter time frames. This program will: 1. Prioritize all watersheds based on level of disturbance and likely sediment and debris contribution. 2. Develop a rehabilitation plan for each watershed. 3. Identify funding and expertise sources for rehabilitation projects. Consider volunteer and private non-profit involvement. 4. Pursue implementation of rehabilitation projects based on the established priorities. • Identifying and prioritizing principal areas of concern in current floodplain management, flood control, and flood mitigation. • Identifying public and private resources that may be used to address these

	principal concerns. • Promoting proactive flood mitigation planning by public and private entities. • Establishing working relationships and partnerships between public and private entities with an interest in or responsibility for flood mitigation.
Background	Floodplains are the natural repositories for floodwaters and buffer the impacts of the flood. When floodplains are encroached upon by development and structures, the storage capacity and buffering capability of the floodplains are reduced. Levees and roads have usually been built adjacent to river channels and restrict access to the normal floodplain. This protects the immediate area (at least temporarily) but increases the flood risk of areas across the channel and downstream. Development in the floodplain may be "flood-proofed" by elevating the structures but this also reduces the storage capacity of the area. While a single or a few structures will have only a limited impact on the natural flood regime, the cumulative impact of significant development over an area can be great. This impact must be mitigated to avoid increased flood severity downstream. Options exist for conserving and increasing the storage capacity of the floodplain without creating undue economic burdens. Flood probability and severity may be directly influenced by upland and upstream actions. Sediment and debris load and runoff timing and quantity play a role in determining when a flood occurs and what its impacts will be. Generally, the greatest source of sediment in the forested watershed is from roads and landslides. Highly unstable channels in disturbed reaches (e.g., where extensive bulldozing or channelization has occurred) can also contribution significant sediment and debris. Land cover changes in upland areas of watersheds increase the amount and velocity of surface runoff from storm events.
Implementation	State
Status	

Strategy	SHMP-HM08: Develop and Implement Techniques for Ice Removal
Actions	Evaluate alternative methods for developing an adequate state-wide response to ice buildup and implement the preferred alternative. Consider at a minimum: • A rapid response team of trained staff and necessary equipment for deployment in critical areas within the state. • Local agencies conduct ice removal operations with State assistance and funding.
Background	Ice jams are common in Idaho. The ability to remove ice from the channel prior to or during a jam in a controlled manner can minimize the damage that would result from flooding.
Implementation	State
Status	

Strategy	SHMP-HM09: Improve Dam Safety
Actions	Improve the State Dam Safety program by: • Requiring flood inundation studies for all high-risk dams and preparing flood inundation studies for existing high-risk dams as funding is available. • Requiring warning systems for all high-risk dams that lack on-site monitoring. • Requiring local jurisdictions to include inundation studies and flood route studies in land-use planning for development below high-risk dams.
Background	Dam failures, although not a frequent cause of flash flooding, can have catastrophic effects when they occur. Large and small dams are located throughout the state and many communities are at-risk from dam failures. The State should continue to invest available resources into improving the dam safety program.
Implementation	State
Status	

Strategy	SHMP-HM10: Assist with the Development of Fire-Resistant Communities
Actions	Provide technical assistance and funding incentives for local communities seeking to integrate urban/wildland interface fire control into land use decisions and land management actions.
Background	Communities can mitigate the urban/wildland interface fire risk by incorporating fire-resistant elements and developing in accordance with the fire hazard. After a community has conducted a general hazard assessment, they can identify areas where fire-resistant elements would be most beneficial. For example, greenbelt or open space projects can reduce the hazard to structures and lives in addition to providing the beneficial community values of recreation and wildlife habitat. These projects need to be carefully designed, located, and maintained to achieve these mitigation goals, though. Deliberate design of landscaping and facilities (e.g., avoidance of "ladder fuels" and combustible building materials and use of drought-resistant plants) can allow the projects to function as fire breaks. Placing these projects in fire-prone areas eliminates the possibility of development at those locations; when placed between existing development and likely wildland fire locations, the projects can be used as fire breaks. Maintenance of landscaping to clear brushy areas and keep the vegetation healthy can help reduce the overall fuel load.
Implementation	State
Status	

Strategy	SHMP-HM11: Reduce UWI Fuel Loads
Actions	Prioritize at-risk communities for the fuel load reduction activities of State and Federal agencies. Increase activities as necessary to reduce the urban/wildland

	interface throughout the state fuel load to a "natural" condition within five years. Encourage Federal and local agencies to also prioritize at-risk communities and increase reduction efforts to meet the five-year goal.
Background	Reduction of fuel in and adjacent to the urban/wildland interface is one of the most direct tools for hazard mitigation. Fuel load reduction activities are routinely undertaken by State, Federal, and local agencies but the task state-wide is dauntingly large. To maximize hazard mitigation, urban/wildland interface areas at immediate risk should be prioritized for fuel reduction activities.
Implementation	State
Status	

Strategy	SHMP-HM12: Develop Water Supply Capacity in the UWI
Actions	Work with local communities to identify areas with insufficient water supply capacity. Assess possible solutions for providing sufficient water or decreasing fire flow requirements (e.g., tanker delivery, automatic sprinkler systems, non-combustible roof materials, and increased defensible space). Encourage the consideration of inter-jurisdictional solutions. Identify technical assistance and funding sources for implementation of the preferred solution.
Background	Fire-fighting water supply is a critical limitation in most urban/wildland interface locations. Local communities often lack the financial and infrastructure resources to provide sufficient capacity. Development of creative solutions may be necessary to meet fire-fighting needs.
Implementation	State
Status	

Strategy	SHMP-HM13: Change Purchasing Specifications for Non-structural Items to Include Seismic Safety
Actions	Update State and school purchasing specifications for non-structural items to seismic safety criteria.
Background	Non-structural hazards can pose significant risks during earthquakes. Careful selection and installation of office and facility objects can reduce the risk.
Implementation	State
Status	

Strategy	SHMP-HM14: Improve School Safety
Actions	Establish a special fund for grants to schools to reduce non-structural seismic hazards.
Background	Schools were damaged in three counties during the Borah Peak earthquake. This fact, and subsequent research, suggests the potential for seismic safety problems in schools through Idaho.

Implementation	State
Status	

Strategy	SHMP-HM15: Provide Funding for County Debris Retention and Collection Systems
Actions	Provide funding, through appropriation or other means, for a grant program to assist counties in installing cost-effective debris retention or collection systems.
Background	Major structural responses to landslide-prone slopes can require capital outlay that exceeds the capabilities of many local communities. The State can reduce its long-term disaster response and recovery costs by appropriating or otherwise securing funding for local mitigation efforts.
Implementation	State

Strategy	SHMP-HM16: Implement Electrical Protective Measures and Backup Systems for State Agencies
Actions	Require state agencies with critical electronic data to implement appropriate protective measures and to maintain off-site data backup.
Background	Lightning can do significant damage to electronic equipment and permanently destroy digital archives. An increasing reliance on electronic media makes this an increasing risk. Lightning strikes are especially risky in older buildings with outdated electrical systems.
Implementation	State
Status	

Strategy	SHMP-HM17: Design State Facilities for Storm-resistance
Actions	Design and construct all State facilities according to standards for projected snow and ice loads.
Background	Structures in winter storm hazard areas should be designed and built to withstand the projected snow (and ice) loads. Non-occupancy buildings, such as greenhouses and storage sheds, which are not subject to building codes should be given special attention.
Implementation	State
Status	

Strategy	SHMP-HM18: Inspect Schools and Other Public Buildings for Snow-load Resistance and Retrofit as Necessary
Actions	Contract with International Conference of Building Officials or similar agency to inspect schools and other public buildings, and make recommendations for retrofitting them to withstand higher snow loads where needed.

Background	In past disasters schools and public buildings suffered collapsed roofs or sustained other structural damage because of heavy snow loading. If the schoolrooms, auditorium or lunchroom had been occupied at the time of these collapses, there would have been severe injury and/or deaths among the students.
Implementation	State
Status	

Strategy	SHMP-HM19: Mitigate Natural Hazard Risk for All State Facilities and Infrastructure
Actions	Develop and implement an aggressive facilities and infrastructure mitigation program. This program will: • Evaluate the natural hazard risk for all State-owned, -managed, or -operated facilities and infrastructure other than dams, bridges, and levees. • Prioritize these facilities and infrastructure based on probability of damage and risk to health and safety and capital investment. • Mitigate the risk to all at-risk facilities and infrastructure, based on the established priorities, by removing from the hazard areas where possible and damage-proofing when necessary.
Background	State facilities and infrastructure located in natural hazard areas place both their occupants/users and capital investment at risk. The public sector often incurs a very high percentage of the damages associated with natural disasters. Roads and other infrastructure are common victims of natural disasters but even office space and parking areas may be at-risk.
Implementation	State
Status	

Strategy	SHMP-HM20: Require Consideration of Proximal Volcanic Hazards in Siting of State Facilities
Actions	Require that State facilities avoid siting critical or high-investment development in probable proximal volcanic hazard zones if suitable alternatives exist.
Background	Mitigation efforts in probable proximal hazard zones should take a long-term approach. Although unlikely, volcanic activity in the Snake River Plain or Yellowstone areas could result in loss of costly public facilities. Avoiding unnecessary facilities in these areas will reduce the overall disaster cost if an event does occur.
Implementation	State
Status	

Strategy	SHMP-HM21: Improve the assessment and prioritization of needs in regional communities.
Actions	Support the formation of regional cooperative fire/emergency service groups.

Background	Multiple fire fighting organizations or agencies may be involved, requiring a high level of communication and coordination of resources. Urban/wildland fires pose a mix of conditions that are not wholly suited for either wildland or urban fire control techniques
Implementation	State/local
Status	

INFORMATION/EDUCATION

Strategy	SHMP-IE01: Increase Public Awareness of Flood Hazards and Mitigation Possibilities
Actions	Assist local governments in conducting flood awareness programs targeted at the high-risk portions of their jurisdictions. These programs should use a variety of media and be ongoing, with an emphasis on the winter/early-spring riverine flood and late-spring/early summer flash flood seasons. Disseminate information to local agencies for use in public education programs. Include guidelines for: • Culvert design/placement criteria • Flood damage repair and flood-proofing • Stream bank stabilization • Flash flood hazard evaluation. • Personal evacuation and safety. Assist local governments in implementing a flood insurance awareness program in their communities.
Background	Property owners can greatly lessen future flood damages by utilizing a whole range of home flood-proofing options, culvert design and placement criteria, and streambank stabilization techniques. This information should be made available to every property owner in flood hazard areas. In areas that have not seen recent flash flooding, the hazard may be seriously undervalued due to a lack of obvious remainders (such as large river channels). Many residents may be unaware that they live in high-risk areas. Residents and property owners can greatly lessen future flash flood damages through careful location of structures, floodproofing of vulnerable property, and knowledge of proper evacuation methods and routes. This information should also be made available to every resident and property owner in flash flood hazard areas. Individual, unavoidable losses may be effectively mitigated through National Flood Insurance Program (NFIP) insurance. Citizens should be made aware of its availability, cost, and benefits.

Implementation	State
Status	

Strategy	SHMP-IE02: Establish a Flood Awareness Week in Idaho
Actions	A proclamation by the Governor establishing the Flood Awareness Week would act as the impetus to a myriad of flood educational events including: NFIP workshops for elected leaders, local emergency services coordinators, insurance agents, realtors, etc.; multi-agency workshops on flooding and watershed management; flood disaster training exercises; mass dissemination of educational materials; and, regional press releases.
Background	Preparation for the next flood is an ongoing process. Educating citizens/institutions at every level of society about the economic and ecological impacts of flooding is the first step in developing a comprehensive State-wide approach to flood hazard reduction.
Implementation	State
Status	

Strategy	SHMP-IE03: Develop and Publish a Flood Information WWW Site
Actions	Create a web site that centralizes flood information through linkages with all available flood data sources. Some examples of the data to be accessible through this web page would include stream flow (gauge) data, digital flood map information, weather/forecast data, household hazardous waste information, emergency point of contacts in communities, catalog of agency programs and funding sources, disaster situation reports, National Flood Insurance Program information, National Marine Fisheries Service/U.S. Fish and Wildlife Service data, etc. An 800 number should also be established for citizens requiring flood data who do not have Internet access.
Background	There is a need for a wide variety of water resources and floodplain management information to be readily accessible to citizens, local, and State officials. However, these data are currently presented in numerous formats and are available only to certain groups with knowledge of, and access to, the information.
Implementation	State
Status	

Strategy	SHMP-IE04: Develop and Distribute a Floodplain Conservation Toolkit
Actions	Develop and distribute a "floodplain conservation toolkit" to State and local agencies with floodplain oversight and/or land management responsibilities. This toolkit should include: • A review of potential floodplain conservation methods rated as to cost, required authority, and long-term benefits. • A list of relevant State and other funding resources and assistance pro-

	grams. • Case studies of effective conservation projects from State and local government and the private sector.
Background	Floodplains are the natural repositories for floodwaters and buffer the impacts of the flood. When floodplains are encroached upon by development and structures, the storage capacity and buffering capability of the floodplains are reduced. Options exist for conserving and increasing the storage capacity of the floodplain without creating undue economic burdens.
Implementation	State
Status	

Strategy	SHMP-IE05: Encourage the Use of NOAA Weather Alert Radios in Flash Flood High-risk Areas
Actions	Encourage the use of NOAA Weather Alert radios by residents of high-risk areas. Provide assistance for purchase by low-income residents. Disseminate information on proper use and maintenance of the radios, response to watches and warnings, and evacuation routes and techniques for sheltering-in-place.
Background	Evacuation and sheltering-in-place are the two main public protection strategies. People living in threatened areas should be encouraged to buy NOAA Weather Alert radios. These radios should be kept in the bedroom so that they can provide warnings during the evening hours.
Implementation	State
Status	

Strategy	SHMP-IE06: Develop a State of Idaho UWI Fire Public Education/Outreach Program
Actions	Develop a comprehensive wildland fire education and outreach program under a Wildland/UWI Fire Educator. This program will: • Develop, publish, and disseminate wildland fire safety, management, and ecology educational information (e.g., video, workbooks, and flyers). The educational information should include material explaining the role of fire in various ecosystems (e.g., the canyon country of the Frank Church Wilderness), why and how fuels burn, the basics of fire prediction and modeling, how fires are managed and controlled, and post-fire rehabilitation. This information should be distributed to homeowners, homeowner associations, developers, elected officials, insurance providers, and all other concerned individuals. • Conduct regular wildland and urban/wildland interface fire education conferences around the state. • Work with local emergency services and American Red Cross officials to prepare evacuation guidelines for people with mobility problems. During wildland and urban/wildland interface fire events, educate the public

	about fire concerns and the necessities of activity restrictions. Prepare and publish specific guidelines on home construction, maintenance, and landscaping in the urban/wildland interface. Mail these directly to homeowners in identified interface areas (work with local agencies to identify target areas). Also mail these guidelines to developers with projects in identified interface areas; arrange follow-up meetings with those involved with large projects. Develop an urban/wildland interface fire hazard evaluation form for self-evaluation by homeowners. The form and support materials should be made available through a variety of media including the WWW.
Background	Fire is both a significant hazard and a fundamental ecological force in Idaho. Many residents, especially new arrivals, may be unaware of the extent and history of wildland and urban/wildland interface fire in the state. The urban/wildland interface fire hazard can be significantly mitigated through careful planning and maintenance of interface homes and their landscaping. Many interface residents and developers are unaware of (or unmotivated to act upon) the steps they can take to protect their homes. Additionally, a large percentage of the general public is uninformed about the role of fire in the ecology of Idaho. A solid public understanding of the issues will facilitate sound mitigation policy and actions. The existing authorities within the Idaho Department of Lands could be used to fund a Wildland/UWI Fire Educator. This educator would standardize and focus wildland and urban/wildland interface fire safety, management, and ecology education efforts for maximum results and long-term effects.
Implementation	State
Status	

Strategy	SHMP-IE07: Provide UWI Fire Training Opportunities for Public Officials and Representatives
Actions	Conduct annual, pre-season wildland fire education conferences around the state for local elected officials. Topics should include projected hazard for the coming season; advances in control, management, and mitigation techniques; review of assistance and mitigation resources available; and roundtable discussion of local issues. BDS will evaluate and revise current emergency management training courses to include urban/wildland interface fire mitigation for local government officials.
Background	Educational outreach should include local zoning officials and elected officials to encourage local education and awareness of urban/wildland interface fire hazards as well as liabilities to local governments.
Implementation	State
Status	

Strategy	SHMP-IE08: Conduct Educational Activities Regarding Buildings Techniques that Reduce Seismic Hazards

Actions	Sponsor annual workshops for on Uniform Building Code (UBC) related topics (UBC) for each of the following groups: • Plan Reviewers and Inspectors • Structural Engineers • County and City Officials
Background	Workshops, tailored to specific audiences, can improve the understanding and implementation of seismically resistant building standards. Each of the above groups has individual concerns regarding the UBC and should be reached appropriately. Plan Reviewers and Inspectors need the tools to ensure that plans and buildings meet the requirements of the code. Structural engineers provide support and technical expertise in ongoing and future earthquake hazard reduction efforts. County and City Officials need to understand the issues and concerns addressed by the UBC so that they can provide administrative and political support for its continued implementation.
Implementation	State
Status	

Strategy	SHMP-IE09: Conduct Earthquake Educational Sessions in Idaho Schools
Actions	Conduct one earthquake drill each semester in every school. Implement through the following steps: • Formalize through a directive from the governor. • Conduct drills in all schools in and near UBC Zone 3 during *Earthquake Awareness Month* campaign. • Conduct drills in all urban schools. • Conduct drills in all schools in the state. Implement a hazard awareness and safety plan, especially in un-reinforced masonry buildings, for all schools in Seismic Zones 3 and 4 and in Seismic Zone 2B within 50 miles of Seismic Zone 3.
Background	Basic earthquake safety training in schools can result in a better educated public. These programs can reach beyond the school children and school employee when materials are taken home and shared with family members.
Implementation	State
Status	

Strategy	SHMP-IE10: Develop and Present a Rural Earthquake Project
Actions	Develop and present an educational program aimed at rural communities. Specifically target likely damages and appropriate non-structural falling hazards.
Background	Images of earthquake damage are often urban in character: toppled buildings, large fires, and collapsed freeways, for example. Rural areas can also sustain ex-

	tensive damage, as illustrated by the Borah Peak and Hebgen Lake earthquakes.
Implementation	State (University Extension Service)
Status	

Strategy	SHMP-IE11: Continue the Annual Earthquake Awareness Month Campaign
Actions	Continue the annual Earthquake Awareness Month campaign that provides safety and mitigation materials to every state agency, every school district, and every local jurisdiction.
Background	April has been declared *Earthquake Awareness Month* by the Governor since 1997. This event offers a forum for media and agency campaigns in support of earthquake safety and mitigation awareness.
Implementation	State
Status	

Strategy	SHMP-IE12: Develop a Comprehensive Landslide Awareness Campaign
Actions	Develop material for a state-wide awareness campaign. Distribute information to local agencies describing mitigation measures which can be undertaken by individual home, farm, or business owners. This could take many forms, from informative, general-interest brochures to workshops for county officials and emergency response personnel. Local agencies will disseminate this information to residents and property owners of landslide hazard areas. In addition to general information, develop specifically targeted alluvial fan hazard information for property owners and local agencies regulating development in these hazard areas. Distribute hazard and warning information to schools to promote awareness by children. Work with local agencies to post public notices and/or warning signs in areas that are susceptible to landslides.
Background	Landslide hazard areas are not always apparent to the untrained eye. Informing residents of the potential hazard and steps that they can take to reduce that hazard is the first line of defense. Similarly, local agencies and officials should be made aware of the hazards and effective mitigation strategies so that they can most effectively assist their jurisdictions.
Implementation	State

Strategy	SHMP-IE13: Develop and Implement Coordinated Lightning Educational Activities
Actions	Develop and implement a coordinated, state-wide lightning awareness campaign. Include activities geared towards recreational users of public lands, outdoor workers, and home and business owners. Specific activities should include: • Signs at trailheads and at high mountain trail locations.

	• Training in hazard assessment and proper response for amateur sports officials and farm supervisors.
Background	Currently, there is no state-wide educational effort. A coordinated approach would ensure that all citizens and visitors are reached with necessary information.
Implementation	State
Status	

Strategy	SHMP-IE14: Develop a Comprehensive Avalanche Awareness Campaign
Actions	Develop a state-wide avalanche awareness campaign, disseminating the information through broadcast and print media, the WWW, equipment rental agreements, use permitting, and trail head signage. Specifically target backcountry recreational user who may be at risk but are unlikely to be involved in existing training programs (e.g., occasional or one-time snowmobilers, skiers, and snowshoers).
Background	The vast majority of avalanche injuries and death occur in the undeveloped backcountry. Users must be educated about hazards prior to engaging in hazardous activities. Casual winter backcountry users, those who head into the backcountry once or only occasionally and lack any formal training, may be at greatest risk. Advances in equipment over the last decade (e.g., more powerful snowmobiles and lighter, more user-friendly snowshoes) have opened up large, potentially hazardous areas to a growing group of these casual users.
Implementation	State
Status	

Strategy	SHMP-IE15: Coordinate Drought Information Efforts
Actions	Coordinate State and other agency drought information efforts. Develop an overall plan for reaching target groups and designate responsibilities.
Background	A number of State, Federal, and local agencies disseminate drought and water conservation information. Coordination of these resources could allow for a more effective overall effort and assurance that all targeted groups are reached.
Implementation	State
Status	

Strategy	SHMP-IE16: Develop and Implement Coordinated Wind Hazard Educational Activities
Actions	Develop and implement a coordinated, state-wide wind hazard awareness campaign. Include educational activities to: • Inform contractors and the public about selection of appropriate building materials and techniques for new construction and retrofitting existing structures.

	• Inform property owners about non-structural retrofitting techniques.
Background	Currently, there is no state-wide educational effort. A coordinated approach would ensure that all citizens and visitors are reached with necessary information.
Implementation	State
Status	

Strategy	SHMP-IE17: Conduct Storm-Resistant Building Design Training for Building Officials and Inspectors
Actions	Conduct a seminar for building officials and building inspectors on snow loading potential, the design of structurally-sound buildings, and code requirements.
Background	Local building officials should be provided current information on potential snow loading in their respective jurisdictions, design and construction of structurally-sound buildings capable of supporting heavy drifted snow loads, with high wind loading, and appropriate code requirements. The Division of Building Safety conducts an annual seminar for design professionals on the design of educational buildings. This would be an excellent venue to extend participation to building officials and inspectors.
Implementation	State
Status	

Strategy	SHMP-IE18: Conduct Storm-resistant Building Materials and Techniques Training
Actions	Conduct educational activities to inform contractors and the public about selection of appropriate building materials and techniques.
Background	In areas without building codes that address storm hazards, contractors and the public may not have guidance in appropriate building materials and techniques. Older (pre-code) structures and non-occupancy structures (e.g., poultry houses, sheds, and greenhouses) may not be able to withstand storm impacts. Owners of these structures, as well as potential owners, should be made aware of the hazard presented by storm events and informed of retrofitting options.
Implementation	State
Status	

Strategy	SHMP-IE19: Develop a Post-Disaster Public Information Campaign
Actions	Take advantage of the post-disaster recovery phase to increase community awareness of local and state emergency operations planning, resources, and information by having communication programs in place prior to events. Coordinate a program to make emergency assistance information available to local communities: • Inventory public and private available resource material; identify and fill gaps.

	• Explore avenues for increasing public awareness of preparedness and mitigation through videos, flyers/brochures, and web resources.
Background	The attention and media focus generated by disasters make the response and recovery phase an excellent time to communicate flood hazard and mitigation messages to the public. Similarly, local governments have the advantage of being able to personalize the message and help bring it home with local examples. Informed residents and property owners are the first line of attack in a coordinated mitigation effort.
Implementation	State
Status	

Strategy	SHMP-IE20: Work with Local Officials to Develop Their Understanding of Natural Hazard Issues and Ability to Perform Emergency Management and Mitigation Functions Effectively
Actions	Encourage public entities responsible for facilities/structures in natural hazard areas to understand the natural processes. Conduct seminars and workshops for local officials on: • Natural hazard processes. • Natural disasters impacts and costs. • Hazard mitigation plan development. • Consideration of protective natural features in mitigation efforts.
Background	Local governments undertake projects with potential significant impact in natural hazard areas. Natural hazard mitigation practices need to be integrated in decision-making at all levels of government. Integrating protective natural features into mitigation efforts can reduce overall costs and reduce the amount of environmental impact from mitigation actions. The cornerstone of natural hazard loss reduction is the local community natural hazard mitigation plan. The most successful plans are those that coordinate natural hazard loss reduction with other community needs and goals to develop a stronger, more comprehensive program. As a result of sound mitigation planning, many communities across the country have lessened the social and economic costs of flooding while enhancing the quality of life of their citizens. In addition, local mitigation plans are now required by FEMA as a condition of receiving certain grant monies to carryout mitigation projects. To assist local communities in mitigation plan development, the State of Idaho should conduct mitigation plan training for local officials particularly in those communities that have suffered recent disasters.
Implementation	State
Status	

Strategy	SHMP-IE21: Establish a Natural Hazard Awareness Week in Idaho

Actions	The Governor establishes the Natural Hazard Awareness Week by proclamation. Work with local jurisdictions to development parallel local programs that inform the residents and property owners about local hazards and the associated risks. Target high-risk areas at state and local levels.
Background	Preparation for the next disaster is an ongoing process. Educating citizens/institutions at every level of society about the economic and ecological impacts of flooding is the first step in developing a comprehensive State-wide approach to natural hazard reduction. A Natural Hazard Awareness Week would act as the impetus to a myriad of natural hazard educational events.
Implementation	State
Status	

Strategy	SHMP-IE22: Develop and Publish a Natural Hazard Information WWW Site
Actions	Create a web site that centralizes natural hazard information through linkages with all available flood data sources. An 800 number should also be established for citizens requiring natural hazard data who do not have Internet access.
Background	There is a need for a wide variety of natural hazard information to be readily accessible to citizens, local, and State officials. However, these data are currently presented in numerous formats and are available only to certain groups with knowledge of, and access to, the information.
Implementation	State
Status	

Strategy	SHMP-IE23: Encourage Individual Mitigation Efforts
Actions	Damage repair and reduction publications should be widely distributed to citizens in areas where disasters have occurred. Inventory public and private resource material available at State and local government levels and fill any gaps in available information. Encourage the consideration of protective natural features in mitigation efforts. Conduct county-level community disaster education programs based on an inventory of local, State, and Federal assistance and program eligibility. Promote relevant funding and assistance opportunities, such as the minimization alternatives offered through the Small Business Administration loan program and the Individual Family Grants program available to owners of substantially damaged structures.
Background	Many small steps contribute to mitigation. Individual property owners are the best positioned and most knowledgeable to make improvements to their own property. They need appropriate information on damage repair and reduction to effectively recover and mitigate, though. This information may not be readily available to the general public, especially those landowners who do not qualify for assistance programs. Additionally, landowners should be made aware of funding and assistance pro-

	grams available at all levels of government from which they may benefit. Integrating protective natural features into mitigation efforts can reduce overall costs and reduce the amount of environmental impact from mitigation actions.
Implementation	State, Local, and Other
Status	

Strategy	SHMP-IE24: Develop a Natural Hazard Awareness and Mitigation Education Program for State Agency Officials and Employees and Private Critical Facility Personnel
Actions	Work to develop a culture of hazard awareness and mitigation with State government by conducting seminars and workshops for State officials and employees on: • Natural hazard processes. • Natural disasters impacts and costs. • Hazard mitigation. Target and include private critical facility operators where appropriate. Provide technical training in specific mitigation techniques where appropriate.
Background	State agencies undertake projects with potential significant impact in natural hazard areas. Natural hazard mitigation practices need to be integrated in decision-making at all levels of government. Private companies that operate critical facilities can similarly impact, and be impacted by, natural hazards in the state. Education of decision makers at these facilities is crucial for disaster damage reduction.
Implementation	State
Status	

Strategy	SHMP-IE25: Develop and Disseminate Information on Volcanic Hazards
Actions	Develop and disseminate information regarding distal hazards to citizens and property owners through the state. Develop information on proximal hazards. Establish a dissemination system to be activated when the likelihood of an event becomes high and the location is identified.
Background	Due to the infrequent nature of volcanic activity in the state, the public's appreciation of the hazards is limited. Informed citizens and property owners can take steps to minimize the impacts of distal hazards. Information on proximal hazards should be prepared so that it may be readily available if an event does become likely.
Implementation	State
Status	

INFRASTRUCTURE

Strategy	SHMP-IS01: Improve Bridge Safety
Actions	Evaluate the potential of future flood damages during the base flood discharge to existing bridges and overpasses in flood hazard areas. The assessment should identify those transportation structures at risk and develop appropriate retrofitting options. Work with local and other agencies that have transportation structure oversight responsibilities. Implement an aggressive retrofitting programs for at-risk bridges and overpasses. Evaluate and, if found appropriate, authorize by executive action, the use of more conservative event frequencies for design criteria for bridges and culverts.
Background	The designs of many older bridges do not meet current engineering standards. These bridges may be susceptible to failure in the event of significant flooding. In addition to posing immediate health and safety issues, the loss of even a single bridge could cause significant disruptions for isolated communities. Consideration should also be given to adopting more conservative standards for design to allow for a greater margin of safety in newly constructed bridges.
Implementation	State
Status	

Strategy	SHMP-IS02: Enhance Road Drainage Systems
Actions	Identify critical road drainage concerns in landslide-prone and high urban/wildland interface fire hazard areas. Inspect and retrofit road drainage systems in landslide-prone areas, particularly culverts and culvert outfalls. Where potential slides are unavoidable, prepare design standards for culvert and drainage systems to accommodate passage of debris and water without loss of road profile. Work with local agencies to identify concerns on local roads. Identify technical assistance and/or funding sources necessary to upgrade the drainage systems as needed.
Background	When slopes are altered for building of roads or other facilities, the cuts may become unstable due to the loss of support for the undisturbed soil. There are many areas of poorly designed and built roads which should be examined for opportunities to redesign and retrofit these damage prone facilities. Poor maintenance also contributes to infrastructure failure. Secondary county and highway district roads are at much greater risk from damages caused by increased drainage and debris after a wildland fire. Secondary roadway drainage systems are notoriously under-maintained and plagued by de-

	ferred maintenance. The situation is compounded on unimproved gravel or mountainous roads where it is common for culverts and other drainage structures to be "blown out" when gravel or debris blocks water passages. Elimination of these blockages can greatly reduce damage to roads, undercutting of bridges and other structures, and loss of emergency access for rural communities.
Implementation	State
Status	

Strategy	SHMP-IS03: Conduct Non-structural Hazards Evaluation of State Facilities
Actions	Require State agencies to conduct non-structural hazards evaluations for all facilities. Prioritize evaluations of HAZMAT incident response facilities and other critical facilities (e.g., hospitals). Coordinate these efforts with other agency projects (e.g., Idaho Transportation Department for bridge retrofits).
Background	Non-structural hazards can pose significant risks during earthquakes. The dangers of non-structural falling objects are often overlooked unless specifically sought.
Implementation	State
Status	

Strategy	SHMP-IS04: Assist Counties in Mitigating Infrastructure at Risk
Actions	Provide funding, through appropriation or other means, for a grant program to assist counties in identifying transportation routes, infrastructure, and structures at high risk. Develop contingency plans for maintenance of service during landslide events. Install warning systems if appropriate. Provide one-time funding, through appropriation or other means, to the Local Highway Technical Assistance Council to develop maintenance criteria to assist counties in creating priority road systems.
Background	Landslides, although generally limited in spatial extent, can have a significant impact on a community or region when they block or destroy transportation routes, infrastructure, and public structures. Local agencies should prioritize at-risk infrastructure during their mitigation efforts.
Implementation	State

Strategy	SHMP-IS05: Implement Avalanche Control for Frequently Closed Highways
Actions	Inventory avalanche paths that frequently close State roads and investigate the use of control techniques to reduce or eliminate these slides. Implement those techniques found to be cost-effective.
Background	Certain areas of State highways are subject to frequent closures due to avalanches.

	These closures inconvenience residents, constrain use of public lands, and may result in economic losses for businesses. Passive control techniques such as retention, redistribution, and retarding/catchment structures, and active control techniques such as release of suspect slopes through use of explosives, may reduce the frequency of these events.
Implementation	State
Status	

Strategy	SHMP-IS06: Maintain Vegetation Clearance in Utility Rights-of-Way
Actions	Increase the frequency of utility rights-of-way maintenance to clear trees and limbs. Expand/acquire electric utility rights-of-way to restrict encroachment of trees and limbs into the rights-of-way.
Background	Clearing vegetation from utility rights-of-way can reduce potential damage to electric power lines during future severe winter storm events. Expanding or acquiring additional land or easements will allow communities and utility cooperatives to more reliably trim or remove vegetation that infringe upon the right of way.
Implementation	State
Status	

Strategy	SHMP-IS07: Retrofit Utility Lines to Isolate Failures
Actions	Retrofit existing electric utility transmission and feeder power lines with fuse-type devises.
Background	Fuse-type devices selective fail in the event of a fault at a given point in the distribution system, shutting off that portion of the system to prevent failure of the entire electric distribution network.
Implementation	State
Status	

Strategy	SHMP-IS08: Install Utility Lines Underground
Actions	Install future power lines and other cabling underground where feasible.
Background	Underground installation of future power lines can reduce their vulnerability to damage from severe storm events.
Implementation	State
Status	

Strategy	SHMP-IS09: Install Snow Drifting Controls in Critical Areas

Actions	Install snow fencing and/or related technologies in areas where important highways are at-risk of blockage during storm events.
Background	Winds during winter storm events can form large drifts from even small amounts of snowfall, blocking important transportation links. Snow fencing and similar techniques are minor investments in maintaining clear roads.
Implementation	State
Status	

Strategy	SHMP-IS10: Require Consideration of Proximal Volcanic Hazards in Siting of State Infrastructure
Actions	Require that State agencies avoid siting infrastructure in probable proximal volcanic hazard zones if suitable alternatives exist.
Background	Mitigation efforts in probable proximal hazard zones should take a long-term approach. Although unlikely, volcanic activity in the Snake River Plain or Yellowstone areas could result in loss of costly public facilities. Avoiding unnecessary facilities in these areas will reduce the overall disaster cost if an event does occur.
Implementation	State
Status	

REGULATORY

Strategy	SHMP-RE01: Adopt State-wide Floodplain Management Legislation
Actions	Amend Idaho Code to: • Require a flood hazard disclosure on all real estate transactions. • Establish a state-wide building code, i.e., Uniform Building Code for new construction. • Establish tie down and anchoring requirements for manufactured homes located in the floodplain. • Require back-flow valves for all new commercial and residential construction in the floodplain. • Restrict the storage of hazardous materials in the floodplain. Specifically address wellhead and aquifer recharge protection zones.
Background	The State of Idaho can reduce flood disaster response and recovery costs by enacting legislation that will encourage wise development in the floodplain. As flooding is rarely confined by jurisdictional boundaries and upstream communities may impact their downstream neighbors, State-level floodplain management regulation may be appropriate for this issue.

	Key issues to be addressed include: • A law mandating the disclosure of the flood threat on all real estate transactions would assist property owners in making informed decisions in the marketplace. Homeowners that are aware of potential flooding are more prone to take measures to safeguard their property from flood damages, since it is in their best economic interest to do so. This increase in individual flood mitigation will decrease disaster response and recovery costs for governments at every level. • New construction that does not provide minimum standards for life-safety in residential and commercial structures does not complement the investment in mitigation measures directed at flood-prone areas. Currently, no state-wide standards for building construction exist. • During flood events there are commonly episodes of high ground water and infiltration from floods overcoming septic and sewage systems, forcing effluent into homes, causing physical damage and health concerns. Back-flow valves should be required, at a minimum, for all new commercial and residential construction in the floodplain. • Recent flood events have heightened awareness and concerns about the storage practices for hazardous materials including, but not limited to, petroleum products, agri-chemicals and other materials. If these materials are released during flood events or other natural disasters, they pose a significant threat to human health and the environment.
Implementation	State
Status	

Strategy	SHMP-RE02: Revise the State Executive Order on Floodplain Management
Actions	Issue a new State Executive Order on Floodplain Management that addresses, in addition to the material of the current Order, the following floodplain concerns: • Maintenance of riparian zones for water quality and habitat • Restrictions on the funding of new infrastructure in the floodway • Adherence to the rules of the NFIP in State-funded floodplain development
Background	The current State Executive Order on Floodplain Management does not address several pertinent floodplain concerns.
Implementation	State (IDWR)
Status	

Strategy	SHMP-RE03: Update Highway Design Standards
Actions	Amend Idaho Code to require that local highway jurisdictions adopt uniform design standards for bridges and culverts and other waterways, such as low-water crossings, as a condition for receiving state assistance. Intermittent streams

	should use the same standards. Amend Idaho Code to apply the Idaho Department of Water Resources stream crossing standards adopted under the Stream Channel Protection Act to non-forest roads (those not covered by the Forest Practices Act).
Background	The ability of State agencies to provide assistance in response to flood disasters is constrained by their equipment and training. Having to cope with numerous differing infrastructure systems and designs may reduce their effectiveness statewide. Undersized and blocked culverts are a particular hazard during flood events and can lead to washed out roads, parking lots, and damage to structures. An appropriate minimum design standard for culverts is in the range between the 50- and 100-year (base) flood events. Culvert design standards should encompass the requirements of Idaho Code Title 36, Chapter 9, Section 906, to ensure culverts do not impede fish passage.
Implementation	State
Status	

Strategy	SHMP-RE04: Adopt State-wide UWI Fire Hazard Reduction Legislation
Actions	Evaluate the potential for urban/wildland interface fire hazard reduction act and enact such an act if it is found to be appropriate. If a such an act is not enacted, then: 1. Amend Idaho Code to allow for the establishment a legal definition of the urban/wildland interface. Consult with legal and fire experts and promulgate a definition in the Idaho Administrative Rules. 2. Develop fire flow requirements for new development in the urban/wildland interface. Amend Idaho Code to require that a water supply capacity sufficient to meet these requirements be present before or concurrent with new development in identified urban/wildland interface areas. 3. Amend Idaho Code to require disclosure of all pertinent fire hazards during real estate transactions involving properties located in identified urban/wildland interface areas. 4. Amend Idaho Code to require that roads meeting fire equipment access and egress standards be present before or concurrent with new development in identified urban/wildland interface areas. 5. Amend Idaho Code to require new development or significant remodeling projects in identified urban/wildland interface areas meet building material and location safety standards. These standards should include fire flow requirement reduction incentives for fireproof development
Background	The State of Idaho can reduce the urban/wildland interface fire hazard by enacting legislation that will encourage wise development and use of the interface. As wildland fires are rarely confined by local jurisdictional boundaries, State-level regulation may be appropriate for this issue. The legislature should carefully con-

sider the costs and benefits of such sweeping legislation, though.

Less broad measures may be more appropriate for the short-term. Key issues to be addressed include:

1. A concise and legally-precise definition of the urban/wildland interface is needed before regulations can be enforced.
2. Fire-fighting water supply is a critical limitation in most urban/wildland interface locations. Rapid growth and development in the interface may out pace a local jurisdictions ability to increase its water supply capacity.
3. Disclosure of the fire hazard during all real estate transactions would assist informed decision making in the marketplace. Homeowners that are aware of potential fires are more prone to take measures to safeguard their property from damages, since it is in their best economic interest to do so. This increase in individual mitigation will decrease disaster response and recovery costs for governments at every level.
4. Effective and safe fire control operations depend on sufficient provision for fire equipment access and egress. Road width, slope, and surface must be appropriate for fire equipment and the roads must be maintained free from obstruction. Turnarounds must be provided in dead-end areas and all bridges must be rated to a sufficient load for responding fire equipment.
5. Building materials and on-site location can play a key role in mitigating urban/wildland interface fire hazards. Fire hazard can be mitigated by requiring Class "B" or better roofing materials and enforcing general fire-resistant building design criteria (e.g., limited window surface and fire-resistant materials). Structures should also be setback on hill and ridge tops at least 30 feet from edge of slop (steep slope require 100-foot or larger setbacks).

The National Fire Protection Association (NFPA) Standard 299:Protection of Life and Property from Wildfire is a national standard that provides suggested criteria for fire-safe development in areas that may be threatened by wildfire. NFPA Standard 299 presents minimum planning criteria for the protection of life and property from wildfire, and it outlines standardized procedures for addressing the following issues:

- Evaluation of the urban/wildland interface (includes fuel, slope, hazard ratings, additional factors);
- Street design;
- Signage of streets and buildings;
- Emergency water supplies; and
- Structural design and construction.

This document can serve as the basis for addressing the above identified issues.

A Governor's task force encompassing a broad range of representatives may also be used to develop minimal fire safety standards and practices in urban/wildland interface areas. Task force memberships should include: home owners, local elected officials, planning and zoning officials, insurance companies, bankers and

	lenders, architects, developers, builders, contractors, the State Fire Marshal, the state fire chiefs association, the police and sheriffs associations, EMS, Bureau of Disaster Services, Department of Lands, Idaho Survey and Rating, BLM, USDA Forest Service, and FEMA.
Implementation	State
Status	

Strategy	SHMP-RE05: Develop a Seismic Task Force
Actions	Develop a State-level Seismic Task Force to coordinate research, research mitigation options, and promote hazard awareness. The task force will be composed of State agency personnel, University faculty, local representatives, and private experts.
Background	A Seismic Task Force could serve as an aggressive proponent for research and ongoing mitigation efforts. Although State agency already have some responsibilities for earthquake and seismic event oversight, the task force could bring together experts from across the state in a non-bureaucratic setting.
Implementation	State
Status	

Strategy	SHMP-RE06: Adopt State-wide Building Safety Codes
Actions	Issue a State Executive order parallel to Federal Executive Order 12699 creating seismic safety standards for state-owned, -leased, or -supported construction. Adopt and maintain the current Uniform Building Code on a state-wide basis to ensure minimum life-safety standards for new construction. Provide for a fee structure to ensure adequate plans review, inspection, and enforcement at the local level. Adopt the Uniform Code for Building Conservation on a state-wide basis to ensure that buildings whose life expectancy is extended through remodeling or rehabilitation provide minimum life-safety standards appropriate to the type of construction. Require that local jurisdictions include geological and geotechnical studies in land-use planning for development near earthquake faults. Require that local jurisdictions include appropriate technical studies in wind and snow load hazard areas.
Background	Well constructed buildings can make the difference between life and death during major earthquakes. The State should set the standard for responsible action by upholding a high level of seismic safety in its construction projects. Adoption of a state-wide building code would provide certainty for consumers and developers and protect the public's safety and welfare. The Uniform Building Code standards are based on local risk and consequently will not place undue burdens on residents and property owners in low-risk areas. Local jurisdictions remain the primary institution for monitoring building con-

	struction standards. Integration of geotechnical and other studies into development requirements for at-risk areas will ensure that adequate safety measures are included in design and construction.
Implementation	State
Status	

Strategy	SHMP-RE07: Mandate State Tax Credits for Residential Earthquake Mitigation Projects
Actions	Amend Idaho Code to provide State income tax credits for homeowners for legitimate seismic hazard mitigation projects. Develop criteria for project approval and provide informational material to homeowners on request.
Background	Many older homes fall to meet modern seismic safety standards. Retrofitting these homes can greatly reduce the state's seismic vulnerability and decrease potential future disaster costs. A tax credit represents a good investment.
Implementation	State
Status	

Strategy	SHMP-RE08: Improve Local Management of Landslide Hazard Areas
Actions	Direct by executive action that the Attorney General take appropriate measures to ensure compliance with the Local Land Use Planning Act of 1975 (Idaho Code 67-65), specifically that local jurisdictions include event histories and the results of geological/geotechnical studies in land-use planning for new development. Provide one-time funding to the Bureau of Disaster Services to lead an interagency team to develop guidelines for local jurisdictions regarding development on alluvial fans and for minimum setbacks for sensitive or high-hazard areas. These guidelines should include provisions to: • Require a geotechnical study to confirm safety of potential development in hazard areas where development is not prohibited. • Require landslide insurance for development in landslide-prone areas. Assist local jurisdictions in funding inspectors to manage development on hazardous and sensitive areas; funding to be provided by a state-wide surcharge on building permits. Amend Idaho Code to require disclosure of hazard areas on alluvial fans and debris flow areas during property transactions. Site evaluations should be performed by qualified, registered professionals with expertise in landslide evaluation and mitigation techniques and the disclosure should be included on reports and maps in non-technical language. Site evaluations should become public records to be included in the state-wide landslide database.
Background	The most effective form of landslide mitigation is control of development in hazard areas. In Idaho, land use planning and control is under the jurisdiction of local governments. Local governments should be given the tools, and reminded of their responsibilities, to perform these tasks.

Status	

Strategy	SHMP-RE09: Prohibit the Construction of Public Facilities in Landslide Hazard Areas
Actions	Amend Idaho Code to prohibit permitting or public financing of public facilities in landslide-prone areas. Roads and related transportation infrastructure, utilities, and other location constrained facilities may be constructed, with proper hazard management, in landslide-prone areas when no feasible alternatives exist.
Background	Public facilities represent large public capital outlays and are generally very difficult to replace. Disaster costs may be minimized by keeping public facilities out of harm's way whenever possible.
Implementation	State
Status	

Strategy	SHMP-RE10: Mandate Tie-downs for Non-permanent Manufactured and Mobile Homes
Source	draft
Actions	Amend Idaho code to require tie-downs for non-permanent manufactured housing units and mobile homes.
Background	Manufactured housing units and mobile homes are typically damaged at lower wind speeds than traditional frame homes. Sufficient anchoring can increase the wind resistance of these structures.
Implementation	State
Status	

Strategy	SHMP-RE11: Develop a Mitigation Project Prioritization Method
Actions	Develop a method for prioritizing mitigation projects. Make this method available to State and local agencies.
Background	Funding for mitigation projects is always limited. The ability to rationally prioritize mitigation projects is essential in achieving the greatest return on funding.
Implementation	State
Status	

Strategy	SHMP-RE12: Support Local Natural Hazard Mitigation Projects
Actions	Support natural hazard mitigation projects: • Establish a Local Natural Hazard Mitigation Project Coordination program in an appropriate State agency. This program will serve as the primary point of contact for local representative seeking technical and funding assistance. Program staff will have the capability to evaluate the local

	communities needs and arrange contact between the communities and appropriate State and other agencies and programs. • Establish a Local Natural Hazard Mitigation Project fund that will make competitive grants available to local communities. Grants will be made annually and local communities will be required to have an approved natural hazard mitigation plan.
Background	While the State generally has more resources to bring to natural hazard mitigation projects, local communities often have a greater awareness of their local natural hazard issues. Promoting local involvement in natural hazard mitigation also builds support for projects and helps maintain long-term interest in their success. It is therefore effective for the State to make resources and expertise available to local communities and to encourage the communities natural hazard mitigation actions.
Implementation	State
Status	

Strategy	SHMP-RE13: Require Disclosure of Natural Hazard Conditions in Real Estate Transactions
Actions	Expand current legislation relating to disclosure of pre-existing conditions in real estate transactions to apply to new developments and to make noncompliance subject to prosecution and fine.
Background	Current disclosure requirements exempt new development. As population growth continues at a rapid pace, new development constitutes an increasingly large percentage of the available housing stock. Exempting these homes exposes a large percentage of home buyers to risks of which they may be unaware.
Implementation	State
Status	

Strategy	SHMP-RE14: Identify Potential Funding Gaps in Mitigation Activities
Actions	The State should identify potential funding gaps in mitigation activities and consider what actions can and should be taken to address them.
Background	Mitigation funding is available from a variety of sources. This patchwork availability does not guarantee that all needs are might. A comprehensive examination of the situation will allow for identification of unmet needs.
Implementation	State
Status	

Strategy	SHMP-RE15: Support Improved Land Use Management by Local Governments
Actions	Support local hazard management efforts by increasing State staffing and frequency of contact with local agency representatives for training and technical assistance. Use this contact to:

	• Facilitate the review of current, and development of more effective, development and land use codes and regulations. In particular, local governments should re-evaluate current codes in light of flash flood events and explore the option of increasing their inspection and compliance resources. • Assist local governments in the enhancement of permitting procedures to facilitate and ensure compliance. • Support the efforts of local governments to engage in comprehensive land use planning for their jurisdictions or portions of the jurisdictions that are hazard-prone. • Implement State-wide guidelines and requirements to constrain inappropriate development and reduce encroachment into hazard-prone areas. These should be based on a review of existing local land-use/construction codes and ordinances. Provide funding assistance for the development of local codes and ordinances that comply. Non-compliance with the guidelines and requirements will restrict local governments from receiving response and recovery funding from the State (for both State declarations and as the non-Federal match for Federal declarations).
Background	Additional planning can strengthen hazard management by integrating it into the community's overall vision of the future. Comprehensive plans and land-use plans specify the types of development in a community and where development should or should not occur. These plans help to tailor land use with the land's capabilities and hazards. For instance, flash flood hazard areas can be used for parks, wildlife refuges, golf courses or similar uses that are compatible with the natural process (provided sufficient warnings systems are included). Plans like this can help shape other local measures, such as zoning ordinances and capital improvement projects.
Implementation	State
Status	

Strategy	SHMP-RE16: Improve Intergovernmental and Public/Private Coordination during Disaster Response and Mitigation
Actions	Draft an interagency plan and/or agreement to define the various State agencies' scope of responsibility and to delegate emergency authority for technical personnel from involved agencies to provide assistance/information on emergency response work. Develop or update Emergency Operation Plans at all levels of government to include standard operating procedures, Memorandums of Agreement, mutual aid, and cooperative procedures for notification, call-down rosters, evacuation, and disposition of hazardous materials during and after natural hazard events. Develop a central repository of these plans to be maintained by Idaho Bureau of Disaster Services and reviewed annually. Conduct annual exercises and training activities to evaluate and revise these plans. Enhance coordination between Federal and State agencies representatives, city and county officials, and private individuals during disaster response and recovery ac-

	tions. Provide outreach efforts for individuals hesitant to contact government agencies.
Background	Coordinating the activities and policies of disaster response and mitigation agencies leads to more effective and efficient actions. Resources may be directed to the most appropriate need and information may be freely shared. Technical advice for reducing life and property immediately following a disaster without seriously compromising natural processes and fish and wildlife habitat is essential.
Implementation	State
Status	

Strategy	SHMP-RE17: Require Local Governments to Consider Natural Hazards in Land Use Planning Decisions
Actions	Amend Idaho Code to require that local governments include natural hazard event histories and the results of risk assessment studies in land use planning for new development.
Background	Natural disaster loses can be effective reduced through rational land use planning informed by knowledge of natural hazards. Natural hazard risk should be a major factor in the land use decision making process.
Implementation	State
Status	

Strategy	SHMP-RE18: Improve State Permitting Procedures
Actions	The State should perform a review and revision of all permitting processes related to natural hazards damage potential. The processes should be updated to reflect an emphasis on: • Ensuring compliance with the standards that the permit enforces. • Minimizing the obstacles faced by the permittee. • Increasing the educational content to the level that the permittee is well informed and supportive of the need for the permit and the standards that it enforces.
Background	A variety of land use and development activities that relate to natural hazard risk (e.g., road construction) require State permitting. The permit process serves two important purposes, ensuring compliance with standards and informing the permittee of the rationale behind and the benefits from these standards. Citizens, however, are likely to avoid (if at all possible) processes that are perceived as onerous. Such avoidance risks increased future natural hazard damage potential through both non-compliance with standards and a less informed citizenry. It is therefore in the State's interest to streamline the permitting process.
Implementation	State

Status	

Strategy	SHMP-RE19: Increase Mitigation Funding
Actions	In addition to the use of State emergency funds as a match for mitigation projects, other mitigation funding sources should be pursued, such as a supplemental Community Development Block Grant appropriation, or funds from environmental fines. Partnerships among all agencies with a stake in hazard reduction should also be encouraged and strengthened. Community Development Block Grant funds should be made available as grants and loans for individual property improvements to minimize future losses.
Background	Additional funding will allow additional mitigation at a property owner level. Hazard Mitigation Grant Program (HMGP) funds are provided on a 75 percent Federal and 25 percent non-Federal cost basis. Many communities are unable to sponsor an HMGP project, because they lack the means to provide the 25 percent match. If a non-Federal match is unavailable, many worthwhile mitigation projects will never come to fruition.
Implementation	State
Status	

Strategy	SHMP-RE20: Form a State Interagency Mitigation Commission
Actions	The Governor appoints a State Interagency Mitigation Commission based on the existing Joint Federal/State Interagency Hazard Mitigation Team approach.
Background	After each of the recent Presidential Declared Disasters, Idaho Bureau of Disaster Services, with assistance of the Federal Emergency Management Agency, has convened a Joint Federal/State Interagency Hazard Mitigation Team to advise the State on mitigation activities recommendations that would reduce future damages. By creating a more formal process, the State of Idaho can add a measure of continuity and accountability to its efforts to resolve long-term recovery and mitigation issues. The State Interagency Mitigation Commission should meet on a regular basis and report to the Governor and other Idaho Department senior officials on the status and progress in resolving mitigation and recovery issues. This Commission could also establish short-term multi agency work groups to address specific problems such as post fire rehabilitation, watershed protection, landslides, reducing future flood damages, etc. The Commission would be responsible for: • Assessing the impact of natural hazards on Idaho citizens, its infrastructure, and State resources. • Coordinating the myriad of agency programs and activities. • Collectively identifying problems and developing recommendations to the Governor and Legislature for reducing or eliminating the impacts of natural disasters, to include possible legislative solutions, development of interagency policies, and directives to agencies for coordinated activities.

Implementation	State
Status	

MAPPING & ANALYSIS

Strategy	SHMP-MA01: Improve Collection of Long-term and Real-time Hydrologic Data
Actions	Evaluate existing hydrologic monitoring networks to determine their adequacy for data generation necessary to meet the analysis needs of mitigation and emergency response efforts and expand the networks in areas where hydrologic data are unavailable or limited. Upgrade existing stream gauge system hardware (through satellite telemetry and telephone instrumentation) to give them real-time data transmission capability. Consult with emergency warning and response agencies to determine priorities for conversion of existing gauges and needs for additional gauges. Design and implement an early warning information distribution system to provide response agencies with accurate real-time information for public distribution. Conduct an aggressive effort to gather data on flooding events and hydrology necessary for the development of long-term mitigation plans for watersheds that have previously experienced significant flooding and those with current conditions that are conducive to significant flooding events (e.g., areas with extensive wildland fire burns). Improve the monitoring capabilities of snow-water equivalents at lower elevations in the state.
Background	Flood mitigation is dependent on up-to-date long-term hydrologic data. Such data are necessary to accurately delineate floodplains and determine probable recurrence intervals for significant flood events. This analysis is critical in the design of various structures such as roads, bridges, and levees and the designation of appropriate land use zoning, amongst other mitigation actions. These data, if available on a real time basis, can be invaluable to emergency response agencies during an actual flood event. Presently, a lack of specific real-time stream gauge data limits the ability of flood disaster coordinators to respond adequately.
Implementation	State
Status	

Strategy	SHMP-MA02: Develop and Maintain a Floodplain Hazardous Materials Inventory
Actions	Develop and maintain a hazardous materials inventory for floodplain areas of the state. This inventory can be a subset of the hazardous materials inventory maintained by the Bureau of Hazardous Materials. Furnish the inventory to local, state, and other agencies with response and mitigation responsibilities.

Background	Recent flood events have resulted in the introduction of hazardous materials into the state's watercourses. Increasing development and use of floodplain areas is likely to increase the occurrence of such contamination. Effective mitigation and response requires agencies to know location and composition of hazardous materials in or adjacent to the floodplains.
Implementation	State (Bureau of Hazardous Materials and BDS)
Status	

Strategy	SHMP-MA03: Identifying UWI Fire Risk by Area and Identify Non-protected Areas
Actions	Develop maps that identify the urban/wildland interface fire hazard areas. Distribute to State, local, and Federal agencies. Make available to the public through print and digital media. Identify non-protected areas. Disseminate these data to State, local, and Federal agencies. Make available to the public through print and digital media.
Background	The urban/wildland interface is a concept that is easy to see but difficult to identify. As with all natural hazards, the first step in urban/wildland interface fire mitigation is identification, mapping, and evaluation of the hazard. This will require: • The identification of the urban/wildland interface areas; and, • An evaluation of the probability of fire is these areas. This work will depend on historical data, field work, and aerial photography or satellite data. Prioritization of mitigation actions will depend on an assessment of the ability of fire management entities to control the projected fires.
Implementation	State
Status	

Strategy	SHMP-MA04: Develop UWI Fire Hazard Rating Scale
Actions	Develop an urban/wildland interface fire hazard rating scale for use by State, local, and Federal agencies. This scale should be based on the fuel quantity and quality, proximity to response equipment and personnel, site accessibility, availability of water, and climatic factors. Develop hazard maps to reflect the rating scale. Distribute maps to local agencies for use in land use planning and zoning decisions. Make available to the public.
Background	Prioritization of mitigation actions should be informed by an objective and reliable hazard rating. A scale for rating urban/wildland interface fire hazards should be developed incorporating fire probability and likely severity, available control resources, and potential damage to lives and property.
Implementation	State

Status	

Strategy	SHMP-MA05: Coordinate Scientific Research to Support Seismic Hazard Mitigation Projects
Actions	Coordinate scientific research to support hazard mitigation projects: • Map soils in four major urban areas for land-use planning to enhance the establishment and enforcement of UBC standards of construction. • Research the reaction of earthfill dams to earthquakes.
Background	Many elements of earthquake mitigation are dependent upon application of solid science and research.
Implementation	State
Status	

Strategy	SHMP-MA06: Involve the Five Highest-risk Urban Areas in Seismic Risk Assessment and Mitigation Planning
Actions	Apply the HAZUS model to: • Pocatello • Idaho Falls • Boise/Ada County • Coeur d'Alene • Sun Valley
Background	FEMA's HAZUS model is a powerful tool for risk assessment and mitigation planning. HAZUS generates loss estimates based on regional and local parameters. After initial data development, the model may be used over and over for scenario checking and analysis of potential mitigation efforts.
Implementation	State
Status	

Strategy	SHMP-MA07: Develop a State-wide Landslide Hazard Assessment
Actions	Develop a state-wide Hazard Assessment, including landslide hazard maps, of critical landslide-prone areas in Idaho. The goal of the assessment will be to identify vulnerable communities, lifelines, areas, facilities, and natural resources so that effective mitigation measures can be planned and implemented. This work should be based on an investigation by an interagency team that will conduct an inventory of slope failures, identify problem areas, and expand current mapping to include a GIS-based overlay that identifies active slides and potential problem areas.
Background	A state-wide assessment of landslide hazards is necessary to understand the extent

	of the danger and to establish responsible priorities for mitigation. Landslide hazard maps are an integral part of landslide hazard assessment. They show where landslide processes have occurred in the past, where they occur now, and the probability in various areas that landslides will occur in the future. These maps require analysis of factors such as geology, soils, vegetation, landscape attributes, and land use, and should recognize different kinds of hazards from different types of slope failures.
Implementation	State (Idaho Department of Lands)

Strategy	SHMP-MA08: Update the Idaho Landslide Information Database
Actions	Update the existing Idaho State Landslide Information database and assure that support is available to maintain it as a visible, practical resource. Provide for periodic monitoring. Pursue the development and utilization of a prioritization system as a decision making tool for midterm and long-term landslide needs. This system should be built upon the landslide information database.
Background	A local or state-wide data base is required to monitor active, potentially active, inactive and critical landslide-prone areas. This database could include site specific hazard maps or regional landslide hazard maps with the appropriate accompanying data base. Ideally, these maps would indicate where landslides have occurred in the past, the locations of landslide-susceptible areas and the probability of future occurrences. The landslide data base, including hazard maps, should be readily available to interested state, county and local entities, as well as the general public. A broad scope database provides both site-specific data for mitigation projects and context for regional decision making.
Implementation	State

Strategy	SHMP-MA09: Develop a State-wide Snow Load Hazard Zone Map
Actions	Develop a state-wide snow load hazard zone map based on historic weather and snow fall data. Develop a snow load hazard rating system to be used for classification hazard in the state.
Background	In order to make well reasoned recommendations on local snow load, building standards and retrofitting recommendations, the frequency and probability of large snow accumulations must be understood. This knowledge may be obtained by aggregating and analyzing historic weather and snow load data.
Implementation	State
Status	

Strategy	SHMP-MA10: Improve Rural Area Mapping Capabilities
Actions	Conduct a Geographic Information System/Global Positioning System rural addressing and mapping program. Furnish this data to State, local, and other agencies.

Background	Citizen and agency reporting of events and related-data is address based. Rural areas generally do not have the extensive address-based digital base map required to convert these data to useful mapping information.
Implementation	State
Status	

Strategy	SHMP-MA11: Provide Hazard Assessment and Mapping Information to Local Jurisdictions
Actions	Evaluate current distribution methods for natural hazard information. Improve the methods as necessary to ensure that hazard identification, risk reduction, and land use planning information is brought to the attention of, and provided, to local jurisdictions.
Background	Most local jurisdictions in Idaho lack the resources to conduct hazard assessment and mitigation planning studies. Much work suitable for these uses is conducted by the State and cooperators. If this information is made available to local jurisdictions, they will be able to more adequately address natural hazard concerns.
Implementation	State
Status	

IMPLEMENTATION

Chapter 7 - PRIORITIZATION

Process

The limit on resources available for mitigation efforts requires that the actions recommended in the Plan be prioritized for implementation. The Bureau of Disaster Services will lead an interagency process to determine priority of all the mitigation actions.

Appendix O presents a proposed set of criteria for prioritization. Actual prioritization criteria will be determined during the process.

High Priority Actions

The following mitigation actions have been identified as "High Priority" and should receive immediate consideration by the responsible State agencies.

Hazard Management

Information/Education

Infrastructure

Regulatory

Mapping & Analysis

IMPLEMENTATION RESPONSIBILITIES

Various State agencies have primary responsibility for implementation of these mitigation actions. Lead agencies are identified in this report as a mechanism for staffing an issue and reaching consensus on recommendations. The designation of "Lead Agency" does not necessarily dictate responsibility for implementation of the recommendation or program. This Plan is not meant to change existing agency authorities. Many of these recommendations require close interagency cooperation and comprehensive planning, and may require changes in legislation, rule revision, or amendment to codes for full implementation.

Ultimate responsibility for oversight of implementation of these recommendations lies with the Idaho State Mitigation Commission. Until the Commission is established, that responsibility shall be in the stewardship of the Idaho Bureau of Disaster Services.

Most important in the mitigation effort is local government involvement in the examination and implementation of hazard mitigation alternatives to protect residences, businesses, and infrastructure from future damages. All affected communities should undertake efforts to develop local community hazard mitigation plans to minimize damages from floods, landslides, earthquakes, and other hazards.

MONITORING

A process should be developed to provide an ongoing assessment of the effectiveness of the Plan and the recommended mitigation actions.

BDS will maintain a database, tracking any implementation; advisory input from counties and other agencies. BDS will also publish the data and report on success stories.

PLAN UPDATES

The plan will undergo an annual review by BDS and the Hazard Mitigation Advisory Committee.

The Plan will be updated following Federal Disaster declarations that result in Interagency Hazard Mitigation Team reports.

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APPENDICES

Appendix A
POTENTIAL LOCAL MITIGATION ACTIONS

Hazard Management

Strategy	LOCL-HM01: Clear and Maintain Stream Channels
Actions	Develop and implement an ongoing program of stream clearance and maintenance. This program should follow State guidelines and be undertaken in cooperation with appropriate State agencies. Establish clearance and maintenance procedures for road systems. Coordinate work with the appropriate State agencies before implementing clearance measures. Identify funding sources for stream debris removal and emergency maintenance measures.
Background	The severity of a flood event may be increased when downed trees, sediment deposits, and other debris in stream and river channels restrict the flow of water. Such ponding can result in significant out-of-channel inundation and levee overtopping. Bridges, openings and culverts must be periodically inspected and routinely cleaned prior to, during, and after high water events. In some severely disturbed stream reaches, bulldozing and channelization has resulted in highly unstable channels. Headcutting, channel migration and increased velocity can lead to the downstream migration of gravel which then is deposited in lower velocity areas. This is of particular concern above bridges and where the channel is defined by levees adjacent to residences and roads. Stabilization of disturbed reaches can play an important role in controlling flood damage but all stabilization work must be in accordance with adopted rules for stream channel alterations. Debris jams may be formed when downed trees, sediment deposits, and other debris in stream and river channels collect. When these debris jams break and restrained waters are released suddenly, flash flooding may result. Debris removal should balance flood control needs and other stream functions. Naturally occurring debris provides for fish habitat and stream stabilization and should not be removed when it does not result in excessive constriction at bridge or culvert openings. Coordination with State agencies with stream management duties is necessary to effectively address these issues.
Funding	State, Local, and Other

Strategy	LOCL-HM02: Reduce Repetitive Losses and Damage Claims

Actions	Reduce repetitive flood damage claims by: 1. Identifying individual and locations responsible for repetitive claims from data supplied by BDS and IDWR. 2. Evaluating each situation and developing a range of possible solutions (e.g., on-site mitigation such as elevation or acquisition and relocation). 3. Implementing the most cost-effective solution.
Background	Flooding generally occurs in known flood hazard areas. These areas may experience flooding time and again. Past disaster recovery methods have emphasized restoring residents and property to their original condition. Unfortunately, this has lead to individuals experiencing flood damages repeatedly, as they continue to live in hazardous areas. Reducing these repetitive damages can be a very cost-effective way to reduce long-term disaster costs.
Funding	State, Local, and Other

Strategy	LOCL-HM03: Evaluate and Upgrade Storm Water Facilities
Actions	Evaluate urban storm water facilities, assessing both the assumptions underlying the designs and their performance. Upgrade these facilities as necessary to provide protection from the flash flood events projected by the most current meteorological data and analysis. Consider a "high-risk district" where facilities are built to stricter standards (i.e., they have larger margins of error) than those in other areas.
Background	Flash floods in urban or urbanizing areas may be caused or aggravated by inadequate storm water facilities. Older facilities may be based on outdated designs or event projections.
Funding	State and Local

Strategy	LOCL-HM04: Establish Framework for Emergency Flash Flood Mitigation Projects in High-risk Areas
Actions	Identify and develop funding and technical contacts for emergency mitigation of disturbed or burned slopes on privately-owned lands. These measures may include: • Contour felling of trees. • Tillage and aerial seeding. • Straw wattles. • Contour and hand trenching. • Straw bale check dams. • Construction or improvement of ponds. • Construction of walls to direct the flow of water. • Catch basins.

	• Dams. • Elevation of sections of roads to act as dams.
Background	Wildland fire and other disturbances can temporarily increase the risk of flash flooding. Aggressive measures may mitigate that risk until the natural landscape is restored. While long-term mitigation is best achieved through effective warning, watershed rehabilitation, and appropriate land use and development, structural measures are justified in these "emergency" situation.
Funding	State, Local, and Other

Strategy	LOCL-HM05: Develop a Fire-Resistant Community
Actions	Integrate urban/wildland interface fire control into land use decisions and land management actions. Work with State agencies and adjacent Federal land managers to identify fire hazard priorities and possibilities for mitigation.
Background	Communities can mitigate the urban/wildland interface fire risk by incorporating fire-resistant elements and developing in accordance with the fire hazard. After a community has conducted a general hazard assessment, they can identify areas where fire-resistant elements would be most beneficial. For example, greenbelt or open space projects can reduce the hazard to structures and lives in addition to providing the beneficial community values of recreation and wildlife habitat. These projects need to be carefully designed, located, and maintained to achieve these mitigation goals, though. Deliberate design of landscaping and facilities (e.g., avoidance of "ladder fuels" and combustible building materials and use of drought-resistant plants) can allow the projects to function as fire breaks. Placing these projects in fire-prone areas eliminates the possibility of development at those locations; when placed between existing development and likely wildland fire locations, the projects can be used as fire breaks. Maintenance of landscaping to clear brushy areas and keep the vegetation healthy can help reduce the overall fuel load.
Funding	Local

Strategy	LOCL-HM06: Reduce UWI Fuel Loads
Actions	Work with State and Federal agencies to direct fuel reduction activities to high-risk urban/wildland interface areas. Coordinate local fuel reduction efforts with State and Federal work. Implement a program for the reduction of fuel loads on unimproved lots within the wildland /urban interface. Volunteer labor resources may be available from local community based groups such as Scout troops and charitable foundations as well as area fire departments and others.
Background	Reduction of fuel in and adjacent to the urban/wildland interface is one of the most direct tools for hazard mitigation. To maximize hazard mitigation, prioritize hazard areas for fuel reduction activities.
Funding	State, Local, and Other

Strategy	LOCL-HM07: Develop Water Supply Capacity in the UWI
Actions	Work with State agencies to identify areas with insufficient water supply capacity. Assess possible solutions for providing sufficient water or decreasing fire flow requirements (e.g., tanker delivery, automatic sprinkler systems, non-combustible roof materials, and increased defensible space). Seek funding a technical assistance for implementation of the preferred solution. Consider inter-jurisdictional solutions and coordination of resources with adjacent land managers.
Background	Fire-fighting water supply is a critical limitation in most urban/wildland interface locations. Development of creative solutions may be necessary to meet fire-fighting needs.
Funding	State, Local, and Other

Strategy	LOCL-HM08: Change Purchasing Specifications for Non-structural Items to Include Seismic Safety
Actions	Update local government and school purchasing specifications for non-structural items to seismic safety criteria.
Background	Non-structural hazards can pose significant risks during earthquakes. Careful selection and installation of office and facility objects can reduce the risk.
Funding	Local

Strategy	LOCL-HM09: Improve School Safety
Actions	Establish one-time funding (through bond issuance or other means) to schools to reduce non-structural seismic hazards.
Background	Schools were damaged in three counties during the Borah Peak earthquake. This fact, and subsequent research, suggests the potential for seismic safety problems in schools through Idaho.
Funding	Local

Information/Education

Strategy	LOCL-IE01: Increase Public Awareness of Flood Hazards and Mitigation Possibilities
Actions	Disseminate information or agency guidance for: • Culvert design/placement criteria.

	• Flood Insurance. • Flood damage repair and flood-proofing. • Stream bank stabilization. • Flash flood hazard evaluation. • Personal evacuation and safety.
Background	Property owners can greatly lessen future flood damages by utilizing a whole range of home flood-proofing options, culvert design and placement criteria, and streambank stabilization techniques. This information should be made available to every property owner in flood hazard areas. In areas that have not seen recent flash flooding, the hazard may be seriously undervalued due to a lack of obvious remainders (such as large river channels). Many residents may be unaware that they live in high-risk areas. Residents and property owners can greatly lessen future flash flood damages through careful location of structures, floodproofing of vulnerable property, and knowledge of proper evacuation methods and routes. This information should be made available to every resident and property owner in flash flood hazard areas. Individual, unavoidable losses may be effectively mitigated through National Flood Insurance Program (NFIP) insurance. Citizens should be made aware of its availability, cost, and benefits.
Funding	State, Local, and Other

Strategy	LOCL-IE02: Develop and Publish UWI Fire Safety Educational Material
Actions	Prepare and publish specific guidelines on home construction, maintenance, and landscaping in the urban/wildland interface. Mail these directly to homeowners in identified interface areas. Also mail these guidelines to developers with projects in identified interface areas or incorporate the guidelines into the permitting process; arrange follow-up meetings with those involved with large projects.
Background	Fire is a significant hazard in Idaho. Many residents, especially new arrivals, may be unaware of the extent and history of wildland and urban/wildland interface fire in the state. The urban/wildland interface fire hazard can be significantly mitigated through careful planning and maintenance of interface homes and their landscaping. Many interface residents and developers are unaware of (or unmotivated to act upon) the steps they can take to protect their homes. A solid public understanding of the issues will facilitate sound mitigation policy and actions.
Funding	State, Local, and Other

Strategy	LOCL-IE03: Involve Local Media in UWI Fire Awareness Work
Actions	Publish a special section or air a special program with emergency information about wildland fires. Localize the information by including the phone numbers of local emergency services, the American Red Cross, and hospitals. Report the areas most at risk from wildland fires and let people know of the advantages of

	creating a fire safety zone around structures and of using fire-resistant roofing materials when building or re-roofing. Print or broadcast local building codes and weed abatement ordinances for structures built near wooded areas.
Background	The local media can be a powerful ally in reaching the general public with urban/wildland interface fire safety and mitigation messages. All media from bi-weekly papers to major television stations can work with local government in this important task.
Funding	Local

Strategy	LOCL-IE04: Provide Public Information and Mitigation Recommendations for Earthquakes
Actions	Provide public information and education to discourage new development and encourage the removal of existing development in high hazard areas. Recommend low or no-cost mitigation measures to property owners and residents. Publish or make available information to support these tasks.
Background	Many earthquake mitigation tasks require property owner and resident actions. Creating an informed populace will lead to effective mitigation efforts.
Funding	State, Local, and Other

Strategy	LOCL-IE05: Conduct Earthquake Educational Sessions in Schools
Actions	Conduct one earthquake drill each semester in every school during "Earthquake Awareness Month" campaign. Implement a hazard awareness and safety plan, especially in un-reinforced masonry buildings, for all schools in Seismic Zones 3 and 4 and in Seismic Zone 2B within 50 miles of Seismic Zone 3.
Background	Basic earthquake safety training in schools can result in a better educated public. These programs can reach beyond the school children and school employee when materials are taken home and shared with family members.
Funding	Local

Strategy	LOCL-IE06: Develop a Comprehensive Landslide Awareness Campaign
Actions	Distribute information to residents of hazard zones describing mitigation measures which can be undertaken by individual home, farm, or business owners. This could take many forms, from informative, general-interest brochures to workshops for county officials and emergency response personnel. In addition to general information, specifically target alluvial fan hazard information to property owners and local agencies regulating development in these hazard areas. Distribute hazard and warning information to schools to promote awareness by children.

	Post public notices and/or warning signs in areas that are susceptible to landslides. Include notices on subdivision or development plans indicating slide-prone areas.
Background	Landslide hazard areas are not always apparent to the untrained eye. Informing residents of the potential hazard and steps that they can take to reduce that hazard is the first line of defense.
Funding	State, Local, and Other

Infrastructure

Strategy	LOCL-IS01: Improve Bridge Safety
Actions	Evaluate the potential of future flood damages during the base flood discharge to existing bridges and overpasses in flood hazard areas. The assessment should identify those transportation structures at risk and develop appropriate retrofitting options. Work with State and other agencies that have transportation structure oversight responsibilities. Implement an aggressive retrofitting programs for at-risk bridges and overpasses.
Background	The designs of many older bridges do not meet current engineering standards. These bridges may be susceptible to failure in the event of significant flooding. In addition to posing immediate health and safety issues, the loss of even a single bridge could cause significant disruptions for isolated communities.
Funding	State, Local, and Other

Strategy	LOCL-IS02: Enhance Road Drainage Systems
Actions	Inspect and retrofit road drainage systems in landslide-prone areas, particularly culverts and culvert outfalls. Where potential slides are unavoidable, prepare design standards for culvert and drainage systems to accommodate passage of debris and water without loss of road profile. Work with State agencies to identify critical road drainage concerns in high urban/wildland interface fire hazard areas. Identify technical assistance and/or funding sources necessary to upgrade the drainage systems as needed.
Background	When slopes are altered for building of roads or other facilities, the cuts may become unstable due to the loss of support for the undisturbed soil. There are many areas of poorly designed and built roads which should be examined for opportunities to redesign and retrofit these damage prone facilities. Poor maintenance also contributes to infrastructure failure. Secondary county and highway district roads are at much greater risk from damages caused by increased drainage and debris after a wildland fire. Secondary

	roadway drainage systems are notoriously under-maintained and plagued by deferred maintenance. The situation is compounded on unimproved gravel or mountainous roads where it is common for culverts and other drainage structures to be "blown out" when gravel or debris blocks water passages. Elimination of these blockages can greatly reduce damage to roads, undercutting of bridges and other structures, and loss of emergency access for rural communities.
Funding	State, Local, and Other

Strategy	LOCL-IS03: Conduct Non-structural Hazards Evaluation of Local Facilities
Actions	Require local agencies to conduct non-structural hazards evaluations for all facilities. Prioritize evaluations of HAZMAT incident response facilities and other critical facilities (e.g., hospitals). Coordinate these efforts with other agency projects (e.g., Highway Department for bridge retrofits).
Background	Non-structural hazards can pose significant risks during earthquakes. The dangers of non-structural falling objects are often overlooked unless specifically sought.
Funding	State and Local

Strategy	LOCL-IS04: Identify and Prioritize At-Risk Infrastructure
Actions	Identify transportation routes, infrastructure, and structures at high risk. Develop contingency plans for maintenance of service during landslide events. Install warning systems if appropriate. Designate a priority road system for maintenance and retrofitting prioritization.
Background	Landslides, although generally limited in spatial extent, can have a significant impact on a community or region when they block or destroy transportation routes, infrastructure, and public structures. Local agencies should prioritize at-risk infrastructure during their mitigation efforts.
Funding	State and Local

Regulatory

Strategy	LOCL-RE01: Improve Floodplain Management
Actions	Review current floodplain development and management codes and regulations and revise if necessary. In particular, re-evaluate current codes in light of flood events and explore the option of increasing inspection and compliance resources. Recent flood events suggest that important elements include: • Requiring that mobile homes in floodplains are properly elevated and an-

	chored. • Identifying which uses and associated structures are appropriate for floodplains. • Designation of floodways in all areas that are in close proximity to developed areas. • Establishment of minimum set-back requirements. • Prohibiting or tightly controlling the storage of hazardous materials in the floodplain. Vigorously enforce floodplain code and regulations. Consider the cumulative impacts of variances and exemptions. Engage in comprehensive land use planning for the entire jurisdictions or portions of the jurisdictions that are flood-prone. Gain or maintain compliance with the NFIP requirements. Participate in the Community Rating System by exceeding NFIP standards.
Background	In an effort to reduce losses in flood hazard areas, communities participate in the National Flood Insurance Program (NFIP) and enact floodplain management standards to reduce future losses. Failure to meet NFIP requirements has a significant negative impact on the individual residents and the community as a whole and may make recovery from a flood disaster virtually impossible. The establishment of development permit procedures assists a community in monitoring floodplain development and provides a check and balance for compliance purposes. Communities should be aware that adoption of stronger floodplain management standards will reduce their need for future disaster costs and avoid destruction of property. Comprehensive plans and land-use plans specify the types of development in a community and where development should or should not occur. These plans help to tailor land use with the land's hazards. For instance, flood hazard areas can be used for parks, wildlife refuges, golf courses or similar uses that are compatible with the natural flooding process. Plans like this can help shape other local measures, such as zoning ordinances and capital improvement projects. Some examples of land-use/zoning controls to lessen flood damages may include basement exclusion ordinances in areas prone to subsurface flooding, separate floodplain zoning districts and development setbacks.
Funding	Local

Strategy	LOCL-RE02: Identify Levee Maintenance Needs and Funding Sources
Actions	Evaluate all local levees and identify maintenance needs. Prioritize needs based on risk of failure or overtopping during probable flood flows. Identify funding sources necessary to upgrade levees to provide base flood protection. Evaluate the feasibility of and funding sources necessary for dredging to augment levee protection. Consider implementation of local funding for levee maintenance and repair

	through already established diking districts.
Background	Extensive public and private damages result from overtopping or breaching of levees. Diking Districts or counties need long-term plans and financing sources to maintain levee systems to US Army Corps of Engineers standards. Failure to maintain these standards results in a loss of eligibility for US Army Corps of Engineers' assistance.
Funding	

Strategy	LOCL-RE03: Develop and Implement Flash Flood High-risk Area Land Use and Development Regulations or Guidelines
Actions	Develop land use and development regulations or guidelines to protect current and future property owners, those down slope, and the public investment in infrastructure and response. These regulations or guidelines should be developed with input from property owners, State agencies, and flash flood and land use experts. An emphasis should be placed on appropriate use of the high-risk area (outdoor, durable uses that do not encourage high vulnerability of people or property). Implement the regulations or guidelines as appropriate for the local situation.
Background	In areas that have not seen recent flash flooding, the hazard may be seriously undervalued due to a lack of obvious remainders (such as large river channels). Many property owners may be unaware that their properties lie in high-risk areas. Future flash flood damages may be mitigated through careful location of structures, floodproofing of vulnerable property, and relocation of inappropriate uses. In addition to informing the property owners of the risk, local governments should consider regulations or guidelines controlling use and development of high-risk areas.
Funding	Local

Strategy	LOCL-RE04: Review and Update Storm Water Facility Regulation
Actions	Review storm water facility regulations, assessing both the assumptions underlying the regulations and how well facilities built to these standards have performed. Revise these regulations as necessary to provide protection from the flash flood events projected by the most current meteorological data and analysis. Consider a high-risk area regulatory overlay that imposes stricter standards than those in other areas.
Background	Flash floods in urban or urbanizing areas may be caused or aggravated by inadequate storm water facilities. Ensuring that newly constructed or updated facilities represent the state-of-the-art in design and function can mitigate this risk.
Funding	Local

Strategy	LOCL-RE05: Develop UWI Hazard Reduction Regulations
Actions	Revise local regulations to: 1. Require that a water supply capacity sufficient to meet fire flow requirements

	be present before or concurrent with new development in identified urban/wildland interface areas. 2. Require that roads meeting fire equipment access and egress standards be present before or concurrent with new development in identified urban/wildland interface areas. 3. Require new development or significant remodeling projects in identified urban/wildland interface areas meet building material and location safety standards. These standards should include fire flow requirement reduction incentives for fireproof development
Background	The hazard from urban/wildland interface fires can be reduced by encouraging wise development and use of the interface. Key issues to be addressed include: 1. Fire-fighting water supply is a critical limitation in most urban/wildland interface locations. Rapid growth and development in the interface may out pace the ability to increase its water supply capacity. 2. Effective and safe fire control operations depend on sufficient provision for fire equipment access and egress. Road width, slope, and surface must be appropriate for fire equipment and the roads must be maintained free from obstruction. Turnarounds must be provided in dead-end areas and all bridges must be rated to a sufficient load for responding fire equipment. 3. Building materials and on-site location can play a key role in mitigating urban/wildland interface fire hazards. Fire hazard can be mitigated by requiring Class "B" or better roofing materials and enforcing general fire-resistant building design criteria (e.g., limited window surface and fire-resistant materials). Structures should also be setback on hill and ridge tops at least 30 feet from edge of slop (steep slope require 100-foot or larger setbacks). The National Fire Protection Association (NFPA) Standard 299:Protection of Life and Property from Wildfire is a national standard that provides suggested criteria for fire-safe development in areas that may be threatened by wildfire. NFPA Standard 299 presents minimum planning criteria for the protection of life and property from wildfire, and it outlines standardized procedures for addressing the following issues: • Evaluation of the urban/wildland interface (includes fuel, slope, hazard ratings, additional factors); • Street design; • Signage of streets and buildings; • Emergency water supplies; and • Structural design and construction. This document can serve as the basis for addressing the above identified issues.
Funding	Local

Strategy	LOCL-RE06: Develop Land Use Restrictions for UWI Fire High-Risk Areas
Actions	Implement risk reduction measures through land use planning. Favor open space

	uses for areas with high fire risk and those which could serve as buffers between high-risk areas and existing or planned development. In high-risk areas, cluster development where possible to facilitate response and to ensure that common open space is accessible and useable by fire apparatus.
Background	Communities can mitigate the urban/wildland interface fire risk by incorporating fire-resistant elements and developing in accordance with the fire hazard. After a community has conducted a general hazard assessment, they can identify areas where the hazard is sufficient to warrant restrictions on private development. The community must weigh the value of private property rights versus the local government's obligation to ensure the health and welfare of the entire community
Funding	Local

Strategy	LOCL-RE07: Adopt Uniform Building Code
Actions	Create seismic safety standards for government-owned, -leased, or -supported construction. Adopt and maintain the current Uniform Building Code to ensure minimum life-safety standards for new construction. Provide for a fee structure to ensure adequate plans review, inspection, and enforcement. Adopt the Uniform Code for Building Conservation to ensure that buildings whose life expectancy is extended through remodeling or rehabilitation provide minimum life-safety standards appropriate to the type of construction. Require geological and geotechnical studies in land-use planning for development near faults.
Background	Well constructed buildings can make the difference between life and death during major earthquakes. The government should set the standard for responsible action by upholding a high level of seismic safety in its construction projects. Adoption of a seismic safety building code would provide certainty for consumers and developers and protect the public's safety and welfare. The Uniform Building Code standards are based on local risk and consequently will not place undue burdens on residents and property owners in low-risk areas. Local jurisdictions remain the primary institution for monitoring building construction standards. Integration of geotechnical studies into development requirements for at-risk areas will ensure that adequate safety measures are included in design and construction.
Funding	Local

Strategy	LOCL-RE08: Improve Management of Landslide Hazard Areas
Actions	Include event histories and the results of geological/geotechnical studies in land-use planning for new development, as required by Local Land Use Planning Act of 1975 (Idaho Code 67-65). Amend local development controls to include provisions to: • Require a geotechnical study to confirm safety of potential development in

	hazard areas where development is not prohibited. • Require landslide insurance for development in landslide-prone areas. • Require disclosure of hazard areas on alluvial fans and debris flow areas during property transactions. Site evaluations should be performed by qualified, registered professionals with expertise in landslide evaluation and mitigation techniques and the disclosure should be included on reports and maps in non-technical language. Site evaluations should become public records to be included in the statewide landslide database.
Background	The most effective form of landslide mitigation is control of development in hazard areas. In Idaho, land use planning and control is under the jurisdiction of local governments.
Funding	Local

Mapping & Analysis

Strategy	LOCL-MA01:Identify Flood Hazard Areas
Actions	Conduct an inventory of flood hazard areas within the community. Prioritize the risks to assist mitigation planning. Monitor land use and land cover changes in areas classified as high- and moderate-risk. Update classification as necessary. Investigate the use of new data sources and digital mapping technique to allow for rapid updating of flash flood maps in areas subject to significant land cover changes. Aggressively pursue additional funding sources for mapping and analysis.
Background	Mapping the flood hazard area is the first step in implementing strong, local hazard management programs. Incomplete, inaccurate, and insufficient hazard mapping exists in the state. Such shortcomings lead to ineffective regulation, inappropriate flood insurance premiums and availability, misdirection of mitigation resources. The problem is especially acute in areas that are undergoing rapid development. Local knowledge can enrich flood hazard area identification.
Funding	State, Local, and Other

Strategy	LOCL-MA02: Map UWI Fire Risk by Area and Identify Non-protected Areas
Actions	Develop maps that identify the urban/wildland interface fire hazard areas. Make available to the public through print and digital media. Identify non-protected areas. Make available to the public through print and digital media. Survey homes in high risk areas to provide preplanning information and target

	identified residences with public education efforts.
Background	The urban/wildland interface is a concept that is easy to see but difficult to identify. As with all natural hazards, the first step in urban/wildland interface fire mitigation is identification, mapping, and evaluation of the hazard. This will require: • The identification of the urban/wildland interface areas; and, • An evaluation of the probability of fire is these areas. This work will depend on historical data, field work, and aerial photography or satellite data. Prioritization of mitigation actions will depend on an assessment of the ability of fire management entities to control the projected fires.
Funding	State, Local, and Other

Strategy	LOCL-MA03: Develop a Regional Hazard Assessment
Actions	Develop a regional Hazard Assessment, including landslide hazard maps, of critical landslide-prone areas. Work in conjunction with other jurisdictions as appropriate. The goal of the assessment will be to identify vulnerable communities, lifelines, areas, facilities, and natural resources so that effective mitigation measures can be planned and implemented. This work should be based on an investigation by an interagency team that will conduct an inventory of slope failures, identify problem areas, and expand current mapping to include a GIS-based overlay that identifies active slides and potential problem areas.
Background	A regional assessment of landslide hazards is necessary to understand the extent of the danger and to establish responsible priorities for mitigation. Landslide hazard maps are an integral part of landslide hazard assessment. They show where landslide processes have occurred in the past, where they occur now, and the probability in various areas that landslides will occur in the future. These maps require analysis of factors such as geology, soils, vegetation, landscape attributes, and land use, and should recognize different kinds of hazards from different types of slope failures.
Funding	State, Local, and Other

Appendix B Potential Post-disaster Mitigation Actions

Hazard Management

Strategy	POST-HM01: Inspect and Rehabilitate Levees
Actions	Seek the assistance of the US Army Corps of Engineers to inspect and evaluate affected levees. Identify sites and develop partnerships between dike districts and counties with US Army Corps of Engineers for rehabilitation and maintenance of dikes. Install pump stations where appropriate and necessary for continued function of the levee.
Background	Levees in Idaho range from carefully-engineered, regional projects to emergency response, "bulldozer dikes." Oversight and maintenance are also variable. Post-event inspection is critical to assess a levee's condition and continued ability to function as intended. In order for damaged non-federal levees to be eligible for assistance, levees need to be upgraded and maintained to the US Army Corps of Engineer standards.
Implementation	State and Other

Strategy	POST-HM02: Clear and Maintain Stream Channels
Actions	Implement a program to assist stream clearance and maintenance by local agencies and private individuals and companies. This effort will: • Identify and prioritize potentially critical channels. • Provide State and other resources to assist in clearing critical channels where there is imminent threat of additional damage. • Expand landowner and agency awareness of Best Management Practices (generally accepted, state-of-the-art techniques) for implementing agricultural, mining and forest practices for maintaining stream clearance compatible with fish and wildlife habitat. These Best Management Practices should establish seasonal "work windows" in sensitive fish habitat areas. • Restrict the movement or removal in-channel debris to cases where it poses a significant threat. Relocation of debris to "safe" locations within the channel to maintain fish habitat is preferred over complete removal.
Background	The severity of a flood event may be increased when downed trees, sediment deposits, and other debris in stream and river channels restrict the flow of water. This especially relevant in successive significant flood events. Such ponding can result in significant out-of-channel inundation and levee overtopping. Bridges,

	openings and culverts must be periodically inspected and routinely cleaned prior to, during, and after high water events. Debris jams may be formed when downed trees, sediment deposits, and other debris in stream and river channels collect. When these debris jams break and restrained waters are released suddenly, flash flooding may result. Bridges, openings and culverts must be periodically inspected and routinely cleaned prior to, during, and after high water events. Debris removal should balance flood control needs and other stream functions. Naturally occurring debris provides for fish habitat and stream stabilization and should not be removed when it does not result in excessive constriction at bridge or culvert openings. Coordination among agencies with stream management and flood control duties is necessary to effectively address these issues.
Implementation	State and Other

Strategy	POST-HM03: Address Gravel Deposition in Alluvial Fans
Actions	Implement a program to reduce future damages related to alluvial fan areas: • Evaluate and select long-term measures to correct flood damages as part of the flood recovery effort, such as excavating gravel deposits, raising bridges and roadways, or relocation and zoning. Realign roads/infrastructure to avoid alluvial fans where feasible. • Study long-term trends and dynamic aspects of alluvial fans to ensure problems are not unnecessarily perpetuated. • Address upstream sources of bedload that are increasing the instability of alluvial areas by initiating watershed restoration projects.
Background	An issue related to stream clearance is flood-related gravel deposition in alluvial fans. The gravel erosion/deposition phenomena is dynamic and may, over a period of time, tend to increase the height and breadth of the fans. Proper land management will address frequency and flows, vegetation, erosion, and reduce the need for short-term solutions following flooding.
Implementation	State and Other

Strategy	POST-HM04: Address Ecological Impacts of Urban/Wildland Interface Fires
Actions	Steps to mitigate the above likely impacts include: • Work with Federal and local agencies and landowners to control grasshopper populations at sustainable levels. • Identify areas of noxious weeds, map and record these areas, and control the noxious weeds. Control of the noxious weeds must include immediate control action as well as long term maintenance. • Restore sage grouse habitat by working to reestablish sagebrush communities, including other native plant species. Green stripping with fire-resistant species will help create “living fire breaks” that protect restored sites and existing sagebrush stands.

	• Secure additional funding through USDA Natural Resources Conservation Service and Idaho Soil Conservation Commission to implement conservation practices on pastures with increased Animal Unit Months and duration due to wildland fires. Additional funding is needed for fencing, water sources and technical assistance. Use native grasses and shrubs for rehabilitation work.
Background	Wildland fires can have significant ecological impacts. In a "natural" setting, wildland fires play an important role in maintaining the ecological balance in some ecosystems. The extreme wildland fires that occur when historic fire suppression has resulted in significant fuel accumulations can negatively impact the ecosystem however. Areas that see significant human use and management may also be seriously disrupted by wildland fire when coupled with the impacts of that use and management. Some likely impacts include: • Where rangeland has been burnt over, new growth is highly susceptible to insect infestation. Initially, the grasshopper population will be greatly reduced as a direct result of the fire. However, there is a strong likelihood that grasshoppers will reappear in greater numbers because of decreased predation and competition. This increase in numbers will take place at a time when new grass growth is at its most vulnerable stage. • Invasion or continued spreading of noxious weeds into disturbed areas may occur during and after wildland fires. These areas can be disturbed due to the fire itself, control lines, fire camps, and associated road repairs, upgrades, or new construction. • Sage grouse numbers have declined dramatically in the last decade. Much of this decline can be attributed directly to the conversion of perennial bunchgrass and shrubs range into annual grass. Recurrent fires only enhance the invasion and spread of these annuals. • When grazing allotments are destroyed by wildland fire, the displaced stock will generate grazing pressure on alternate grazing lands. This increase in grazing may impact critical riparian habitat for threatened and endangered species and overall water quality. • Fast-growing, non-native grasses and shrubs may be used to revegetate disturbed areas to fight erosion and landsliding. These non-natives can disrupt the ecosystem of the disturbed area and may result in increased future fire danger. Agencies with responsibility for rangeland rehabilitation need to investigate these situations and develop appropriate mitigation measures.
Implementation	State

Strategy	POST-HM05: Remove Irreparably-Damaged, Unsafe Structures after Earthquakes
Actions	Demolish "red-tagged" buildings and remove the debris.
Background	Severely damaged buildings may remain standing following earthquakes. They

	may continue to pose a threat long after the event when left in this state.
Implementation	

Information/Education

Strategy	POST-IE01: Increase Visibility of the Flood Hazard
Actions	Place vandal resistant, flood-level makers in strategic and prominently visual parts of the urban and river flat areas on county roads and State highway property.
Background	Awareness of flood hazards is highest in the post-event recovery phase but quickly diminishes. In areas that have not seen recent flooding, the hazard may be seriously undervalued.
Implementation	State and Local

Strategy	POST-IE02: Provide Stream Bank Stabilization Technical Advice to Individual Property Owners
Actions	Develop and publish guidelines for the stabilization of existing stream banks and channels to reduce future flood damages. Distribute this material to and meet with landowners of high-risk properties.
Background	Increased runoff, sediment load, and channel disturbance following wildland fires may result in streambank erosion and consequent flooding. Land owners in floodplains and especially those adjacent to active stream channels are likely to be significantly impacted. When the threats arise, land owners will generally try to control the hazards. Inappropriate control actions can have serious fisheries habitat impacts and may worsen the flood damages on adjacent and downstream properties. Channel stabilization of the channel must be done in such a way as to maximize both flood protection and fisheries habitat. The use of vegetative bank-protection works should be a priority in any stabilization project.
Implementation	State, Local, and Other

Strategy	POST-IE03: Develop a Comprehensive Landslide and Flash Flood Awareness Campaign
Actions	Distribute information to occupants of hazard zones describing mitigation measures that can be undertaken by individual home, farm or business owners. Prepare and distribute information concerning the nature of alluvial fan hazards to property owners in high-risk, alluvial fan areas. Share hazard and warning information with the media and schools to promote awareness.

Background	Significant urban/wildland interface fires may place many communities are at risk of increased landsliding and flash flooding. Increased awareness of the hazard will involve the community and at-risk individuals in mitigation.
Implementation	State, Local, and Other

Infrastructure

Strategy	POST-IS01: Clear and Evaluate Road Drainage Systems
Actions	Identify at-risk road drainage systems in the wildland fire area. Clear and repair these systems to ensure full function. Evaluate the design and function of the system and specify improvements if necessary to deal with the post-fire situation. Identify technical assistance and/or funding sources necessary to upgrade the drainage systems as needed.
Background	Secondary county and highway district roads are at much greater risk from damages caused by increased drainage and debris after a wildland fire. Secondary roadway drainage systems are notoriously under-maintained and plagued by deferred maintenance. The situation is compounded on unimproved gravel or mountainous roads where it is common for culverts and other drainage structures to be "blown out" when gravel or debris blocks water passages. Elimination of these blockages can greatly reduce damage to roads, undercutting of bridges and other structures, and loss of emergency access for rural communities.
Implementation	State, Local, and Other

Regulatory

Strategy	POST-RE01: Revise Regulatory Floodplains to Conform with True Flood Extent
Actions	Where inundation exceeds that projected by the FIRM, revise the regulatory floodplain. The revised delineation should be based on observed flood extent or projections of these observation to the base flood extent.
Background	Delineation of areas actually inundated is far more accurate and has much greater utility to planners and regulators than floodplain maps developed by computer-simulation techniques. Furthermore, the maps of areas that were actually inundated can be used to calibrate computer models that can simulate floodplains for floods with a different discharge and frequency.
Implementation	State and Other

Mapping & Analysis

Strategy	POST-MA01: Collect Flood Event Data and Update Data Analyses
Actions	Establish an interagency Flood Data Task Force to analyze the flood event. The Task Force will collect flood data which was not gathered during the event and determine: • Flood extent. • Flood frequency. • Cause and effect of the flooding by watershed. Complete and update (assess the accuracy of existing maps and restudy if needed) flood hazard mapping according to the following priorities: 1. Communities (or portions of communities) that experienced flooding but are not in identified special flood hazard areas. 2. Other communities that experienced flooding.
Background	In order to avoid or minimize repetitive losses suffered from future floods, the State and local communities need to develop long-term strategies and solutions to mitigate future events. To plan effectively, flood characteristics, land use practices and other types of information need to be collected. By bringing all the information together, experts should be able to relate flood conditions to the various parameters. These results can then be a guide for current and future mitigation activities. Flood frequencies derived from past events are an integral part of information needed to: • Design replacement facilities for those that were destroyed or damaged beyond repair by the flood. • Evaluate the cost-effectiveness of hazard mitigation proposals for public facilities damaged by the flood. • Evaluate or revise existing flood insurance rate maps. • Aid city, county and state managers with land-use decisions. Mapping the flood hazard area is the first step in implementing strong, local floodplain management programs. Inaccuracies or a lack of community boundaries in flood maps leads to ineffective regulation of local floodplain ordinances.
Implementation	State, local, and other

Strategy	POST-MA02: Flood Extent Delineation
Actions	Delineate the flood extent and provide these data to local and state officials. Delineation can be accomplished with satellite imagery, aerial photography, and/or field work.

Background	Delineation of areas actually inundated is far more accurate and has much greater utility to planners and regulators than floodplain maps developed by computer-simulation techniques. Furthermore, the maps of areas that were actually inundated can be used to calibrate computer models that can simulate floodplains for floods with a different discharge and frequency. Small scale satellite images and aerial photos taken during the peak of the flood should be overlaid on a large base map and distributed to local and state officials. These maps can especially aid local planners and building officials in encouraging wise floodplain land-use decisions.
Implementation	State and Other

Strategy	POST-MA03: Assess Risks from Post-fire Secondary Hazards
Actions	Perform an immediate study of the principal watersheds affected by wildland fires to evaluate the potential for flood (including flash flood) and landslide hazards. This information is necessary for effective and appropriate mitigation decision making. Develop watershed models based on post-fire conditions. Secure funding, determine and prioritize watersheds for modeling, create the watershed models, and evaluate critical scenarios based on model results.
Background	Post-fire floods (including flash flood) and landslides can occur with little warning, exert unpredictable loads on objects in their paths, strip vegetation, block drainage ways, damage structures, and endanger humans. The potential for severe flooding and landsliding in the areas affected by wildfires should be evaluated at the earliest opportunity following the fire event. This study can use existing GIS data base information such as the USGS Basin Characteristics File to identify the relative hazard in individual burned drainage basins, as well as the threats to human life and property posed by these hazards. Many burned watersheds will experience significant long-term changes in hydrology due to burned vegetation and soils. These changes will impact the timing and magnitude of peak stream flows and the potential for landslides in these watersheds. Development of a watershed model for significantly impacted areas will provide a tool to predict the severity of these impacts and allow mitigation scenarios to be pre-evaluated for their effectiveness.
Implementation	State and Other

Strategy	POST-MA04: Expanding Turbidity and Water Quality Monitoring Systems
Actions	Determine appropriate stream gauging site locations for setup, install turbidity and other water quality sensors, and sustain basic operation and maintenance.
Background	The increased turbidity and other water quality parameters in watersheds that were burned should be monitored in order to assess the severity of impacts on fisheries and to evaluate the effectiveness of mitigation efforts. Existing stream gauging stations can be instrumented with turbidity and other water quality sensors for a relatively low cost and placed at many existing sites. This data can be telemetered by satellite for real-time access to the data.

Implementation	State and Other

Strategy	POST-MA05: Expanding Flood Monitoring and Warning Systems
Actions	Evaluate existing hydrologic monitoring networks to determine their adequacy for floodplain management under post-fire conditions. This includes expanding monitoring networks in areas where hydrologic data is unavailable or limited, and finding ways to integrate information from different systems.
Background	Long-term hydrologic data are a critical element for developing floodplain management strategies. For example, the data is necessary to accurately delineate floodplains for the design of structures such as roads, bridges, and levees. These data, if available on a real time basis, can also be invaluable to emergency response agencies prior to and during actual flood events.
Implementation	State and Other

Strategy	POST-MA06: Review Existing Earthquake Hazard Maps and Reports
Actions	Review existing hazard maps and reports in light of observed impacts from the earthquake. Identify inaccuracies and shortcomings. Develop and implement a research plan to update these maps and reports.
Background	Mitigation efforts are planned and prioritized based on hazard map and reports. These information sources should be updated as new information becomes available.
Implementation	

Strategy	POST-MA07: Conduct a Regional Landslide Assessment
Actions	The post-event assessment should: • Investigate the relationships between geology and soils and the distribution of slides to evaluate factors and processes that triggered landslides. Construct models to predict slide-prone areas and anticipate "triggering events." • Coordinate data from various agencies as a base for hazard mapping.
Background	There is a need to establish the causal factors and processes contributing to extensive landslides. This disaster event has created an ideal opportunity to define the relation between site characteristics and landslide occurrence. Causal factors such as storm characteristics, geology, wildfires, riverine erosion undercutting, road building, and timber harvesting can be identified. Results from this work can be extrapolated to similar sites within an extensive area of Idaho and other western states.
Implementation	State, Local, and Other

Appendix C
Development of the Plan

Overview

The Plan is the first comprehensive, statewide mitigation planning effort to be conducted in Idaho. It represents an ambitious attempt to provide a voice for and direction to natural hazards mitigation in the state. It is, however, a first step in the long process that will be required to minimize the damage done by disasters in Idaho. The Plan will operate as a working document, changing along with our state's continual growth in knowledge and experience relating to natural hazards.

This document represents the current work to date on mitigation in the State. Responsibility for the Plan and its evaluation and revision will remain with BDS. Interested parties should contact:

Bureau of Disaster Services
Military Division
Bldg. 600, 4040 Guard Street
Boise, ID 83705-5004
Email: mitigation@bds.state.id.us
(208) 334-3460

The evolution of the mitigation process will draw upon the experience and expertise of all State agencies and any local agencies and residents who are willing to participate. The future of the process will also depend critically on the resources made available to BDS for this work.

Update Process

BDS will update the Plan when disasters occur in the state, and when significant new information becomes available. Information from future Interagency Hazard Mitigation Team reports will also be included as available.

History

July, 2001
The initial version of the Plan was completed in July, 2001. It drew heavily upon, and incorporates by reference, two previous mitigation plans that were prepared in response to specific Disasters:

- DR-694: Borah Peak Earthquake (1983).[56]
- DR-697: Salmon Ice Jam Floods (1984).[57]

It also incorporated the Interagency Hazard Mitigation Team reports prepared for the last four Federally declared Disasters:

- DR-1102: Panhandle Floods (1996).[58]

[56] State of Idaho. (1985). Section 406 Hazard Mitigation Plan, Borah Peak Earthquake, October 28, 1983.
[57] Idaho Department of Water Resources & Idaho Bureau of Disaster Services. (1985). Hazard Mitigation Report, Salmon Ice Jams, February 16, 1984.
[58] Interagency Hazard Mitigation Team. (1996). Hazard Mitigation Report, Northern Idaho Flooding of 1996.

- DR-1154: Heavy Snow, Landslides, and Floods (1996-97).[59]
- DR-1177: Southeastern Floods (1997).[60]
- DR-1341: Wildland Fires (2000).[61]

Additional contributing documents included:

- Northern Idaho Flood Damage Reduction Plan.[62]
- Recommendations of the Governor's Landslide Task Force.[63]
- Draft Idaho Wildland/Urban Interface Fire Hazard Mitigation Plan.[64]

The state hazard mitigation planning process began in summer of 1996, when BDS convened a group of agency representatives and BDS Area Field Officers (under the title of the State Hazard Mitigation Team) to assess statewide hazards and risks. Over the following several years, the Plan's format was refined and a method for tracking implementation of recommendation was developed.

The wildland/urban interface fires of the summer of 2000 (DR-1341) provided both impetus and opportunity (through Federal funding) for the elements of the Plan to be brought together and finalized. Stephen Weiser, Jonathan Perry, and Doug Pflugh of the Mitigation section of BDS compiled this version during the period of November 2000, to May 2001.

[59] Interagency Hazard Mitigation Team. (n.d.). Interagency Hazard Mitigation Team Report: Heavy Snow, Landslides, and Floods November 1996—January 1997.
[60] Interagency Hazard Mitigation Team. (1997). Interagency Hazard Mitigation Team Report for the Southeast Idaho Counties.
[61] Interagency Wildland Rehabilitation and Hazard Mitigation Team. (2000). Interagency Wildland Rehabilitation and Hazard Mitigation Team Report, Recommendations for Idaho Communities, Infrastructure, and Resources at Risk from Wildfires and Related Events.
[62] State of Idaho. (1996). Flood Damage Reduction Plan, North Idaho Floods.
[63] Governor's Landslide Task Force. (1997). Recommendations for Idaho Communities, Infrastructure, and Resources at Risk from Landslides and Related Events.
[64] Idaho State Bureau of Disaster Services. (2000). Draft Idaho Wildland/Urban Interface Fire Hazard Mitigation Plan.

The initial version of the Plan intended a broad overview of the principal natural hazards in Idaho. Assessments and mitigation strategies for each of these will be expanded as BDS and other resources allow.

Desired Improvements

Potential improvements to this Plan have been identified:

- Consideration of the impact of regional events on Idaho (e.g. Cascadia volcanic events, coastal subduction quake, major wildfire).

Sources of Recommended Mitigation Actions

Recommended mitigation actions presented in this Plan are drawn from a number of sources. The list below provides a key for citations in the following tables. Specific policies from State of Idaho documents are cited when possible. Where no source is given, the recommended mitigation action was developed by BDS staff from professional experience and hazard mitigation standards.

Recommended Mitigation Action Source Key	
Citation	**Source**
0694	Section 406 Hazard Mitigation Plan, Borah Peak Earthquake, October 28, 1983.[65]
0697	Hazard Mitigation Report, Salmon Ice Jams, February 16, 1984.[66]
1102	Hazard Mitigation Report, Northern Idaho Flooding of 1996.[67]
1154	Interagency Hazard Mitigation Team Report: Heavy Snow, Landslides, and Floods November 1996—January 1997.[68]
1177	Interagency Hazard Mitigation Team Report for the Southeast Idaho Counties.[69]
1341	Interagency Wildland Rehabilitation and Hazard Mitigation Team Report, Recommendations for Idaho Communities, Infrastructure, and Resources at Risk from Wildfires and Related Events.[70]
ACEM	Ada County Flood Contingency Plan.[71]
BDSP	Idaho State Bureau of Disaster Services 5-year Mitigation Plan.[72]
Recommended Mitigation Action Source Key (continued)	
Citation	**Source**
DHMP	Preliminary drafts of the State Hazard Mitigation Plan.
FBWF	Backgrounder: Wildland Fires.[73]
FLP1	Flood Damage Reduction Plan, North Idaho Floods.[74]

[65] State of Idaho. (1985). Section 406 Hazard Mitigation Plan, Borah Peak Earthquake, October 28, 1983.
[66] Idaho Department of Water Resources & Idaho Bureau of Disaster Services. (1985). Hazard Mitigation Report, Salmon Ice Jams, February 16, 1984.
[67] Interagency Hazard Mitigation Team. (1996). Hazard Mitigation Report, Northern Idaho Flooding of 1996.
[68] Interagency Hazard Mitigation Team. (n.d.). Interagency Hazard Mitigation Team Report: Heavy Snow, Landslides, and Floods November 1996—January 1997.
[69] Interagency Hazard Mitigation Team. (1997). Interagency Hazard Mitigation Team Report for the Southeast Idaho Counties.
[70] Interagency Wildland Rehabilitation and Hazard Mitigation Team. (2000). Interagency Wildland Rehabilitation and Hazard Mitigation Team Report, Recommendations for Idaho Communities, Infrastructure, and Resources at Risk from Wildfires and Related Events.
[71] Ada City-County Emergency Management. (1999). Ada County Wildfire Contingency Plan. [Electronic Version].
[72] Idaho State Bureau of Disaster Services. (199x). 5-year Mitigation Plan.
[73] Federal Emergency Management Agency. (1998) Backgrounder: Wildland Fires. [Electronic Version].

LSP1	Recommendations for Idaho Communities, Infrastructure, and Resources at Risk from Landslides and Related Events.[75]
LSPX	*Priority Recommendations* from: Recommendations for Idaho Communities, Infrastructure, and Resources at Risk from Landslides and Related Events.[76]
NHMP	State Of New Hampshire Natural Hazards Mitigation Plan.[77]
OTRG	Oregon Technical Resource Guide.[78]
WCPE	Optional Comprehensive Plan Element for Natural Hazards Reduction.[79]
WUIP	Draft Idaho Wildland/Urban Interface Fire Hazard Mitigation Plan.[80]

State-wide Actions

Hazard Management

Action	Source(s)
SHMP-HM01	1102-23a, 1102-23b
SHMP-HM02	1102-24a, 1102-24b, 1102-24c, 1102-24d, 1102-24e
SHMP-HM03	1102-3a, 1102-3b, 1102-3c, 1102-3d, 1102-3e, 1154-17, FLP1-3b
SHMP-HM04	1102-1a, 1102-1b, 1102-1c, 1102-1f, 1102-4a, 1102-4b, 1102-4c, 1102-5c, 1102-5d, FLP1-3c, FLP1-3d
SHMP-HM05	1102-1a, 1102-1b, 1102-1c, 1102-1f, 1102-4a, 1102-4b, 1102-4c, 1102-5c, 1102-5d, FLP1-3c, FLP1-3d
SHMP-HM06	0697-5.5, 1102-7a, 1102-7b, FLP1-3e
SHMP-HM07	1102-7a, 1177-12, DHMP
SHMP-HM08	0697-4.1
SHMP-HM09	DHMP
SHMP-HM10	WUIP
SHMP-HM11	WUIP
SHMP-HM12	OTRG, WCPE
SHMP-HM13	BDSP

[74] State of Idaho. (1996). Flood Damage Reduction Plan, North Idaho Floods.
[75] Governor's Landslide Task Force. (1997). Recommendations for Idaho Communities, Infrastructure, and Resources at Risk from Landslides and Related Events.
[76] Ibid.
[77] New Hampshire Office of Emergency Management. (2000). State Of New Hampshire Natural Hazards Mitigation Plan. [Electronic Version].
[78] Oregon Department of Land Conservation and Development. (2000). Oregon Technical Resource Guide. [Electronic Version].
[79] Washington State Community, Trade and Economic Development. (1998). Optional Comprehensive Plan Element for Natural Hazards Reduction.
[80] Idaho State Bureau of Disaster Services. (2000). Draft Idaho Wildland/Urban Interface Fire Hazard Mitigation Plan.

SHMP-HM14	0694-3d, BDSP
SHMP-HM15	LSP1-13, DHMP
SHMP-HM16	DHMP
SHMP-HM17	-
SHMP-HM18	1154-1
SHMP-HM19	NHMP
SHMP-HM20	-

Information/Education

Action	Source(s)
SHMP-IE01	1102-2b, 1102-25a, 1102-25b, 1177-5, 1177-7, 1177-8, FLP1-4c
SHMP-IE02	1154-0014
SHMP-IE03	1154-12
SHMP-IE04	1102-7a, 1177-12
SHMP-IE05	ACEM
SHMP-IE06	1341-7, 1341-8, FBWF, WCPE
SHMP-IE07	WUIP
SHMP-IE08	BDSP, 0694-4c
SHMP-IE09	0694-5c, BDSP
SHMP-IE10	BDSP
SHMP-IE11	BDSP
SHMP-IE12	1154-9, LSP1-7, LSPX-9
SHMP-IE13	DHMP
SHMP-IE14	DHMP
SHMP-IE15	-

Action	Source(s) (continued)
SHMP-IE16	DHMP
SHMP-IE17	1154-2
SHMP-IE18	DHMP
SHMP-IE19	1102-2b, 1102-25a, 1102-25b, 1177-5, 1177-7, 1177-8, FLP1-4c
SHMP-IE20	1102-27a, 1102-28a, 1177-3, FLP1-4a, FLP1-4b, FLP1-4c
SHMP-IE21	1154-14
SHMP-IE22	1154-12
SHMP-IE23	0697-1.3, 1177-8
SHMP-IE24	-
SHMP-IE25	-

Infrastructure

Action	Source(s)
SHMP-IS01	1177-10, LSP1-17
SHMP-IS02	1341-24
SHMP-IS03	BDSP
SHMP-IS04	LSP1-10, LSP1-22, DHMP
SHMP-IS05	-
SHMP-IS06	-
SHMP-IS07	-
SHMP-IS08	-
SHMP-IS09	-
SHMP-IS10	-

Regulatory

Action	Source(s)
SHMP-RE01	0697-5.3, 1102-15a, 1102-19a, 1154-17, 1177-15, 1177-16
SHMP-RE02	1154-16
SHMP-RE03	1102-2a, 1341-19, LSP1-16
SHMP-RE04	WCPE, DHMP
SHMP-RE05	0694-1i
SHMP-RE06	BDSP, DHMP

Action	Source(s) (continued)
SHMP-RE07	BDSP
SHMP-RE08	1154-7, LSP1-14, LSP1-18, LSP1-19, LSPX-3
SHMP-RE09	-
SHMP-RE10	DHMP
SHMP-RE11	LSPX-10
SHMP-RE12	LSPX-7, DHMP
SHMP-RE13	LSP1-15
SHMP-RE14	LSP1-25
SHMP-RE15	0697-5.3, 1102-15a, 1102-19a, 1154-17, 1177-15, 1177-16
SHMP-RE16	0697-5.4, 1102-10a, 1102-21a, 1102-26a, 1102-26b, FLP1-1a, FLP1-1e
SHMP-RE17	DHMP
SHMP-RE18	DHMP
SHMP-RE19	0697-1.4
SHMP-RE20	1341-1

Mapping & Analysis

Action	Source(s)
SHMP-MA01	1102-17a, 1102-17b, 1154-21, FLP1-2a, FLP1-2b, LSP1-9
SHMP-MA02	1102-22a, 1102-22b, FLP1-2d
SHMP-MA03	WUIP
SHMP-MA04	WUIP
SHMP-MA05	BDSP, DHMP
SHMP-MA06	BDSP
SHMP-MA07	LSP1-1, LSP1-12, LSPX-2, DHMP
SHMP-MA08	LSP1-3, LSPX-8, LSP1-24
SHMP-MA09	1154-3
SHMP-MA10	1102-18b
SHMP-MA11	-

Potential Local Mitigation Actions

Hazard Management

Action	Source(s)
LOCL-HM01	1102-3a, 1102-3b, 1102-3c, 1102-3d, 1102-3e
LOCL-HM02	-
LOCL-HM03	-
LOCL-HM04	DHMP
LOCL-HM05	WUIP
LOCL-HM06	WUIP
LOCL-HM07	OTRG, WCPE
LOCL-HM08	BDSP
LOCL-HM09	0694-3d, BDSP

Information/Education

Action	Source(s)
LOCL-IE01	1102-2b, 1102-25a, 1102-25b, 1177-5, 1177-7, 1177-8
LOCL-IE02	-
LOCL-IE03	FBWF
LOCL-IE04	0694-2b, 0694-3c
LOCL-IE05	0694-5c, BDSP
LOCL-IE06	1154-9, LSP1-7, LSPX-9

Infrastructure

Action	Source(s)
LOCL-IS01	1177-10
LOCL-IS02	1341-24
LOCL-IS03	BDSP
LOCL-IS04	LSP1-10, LSP1-22, DHMP

Regulatory

Action	Source(s)
LOCL-RE01	0697-1.1, 0697-1.2, 0697-3.2, 1102-12a, 1102-12b, 1102-12c, 1102-13a, 1102-13d, 1102-19a, 1177-13, 1177-14
LOCL-IS02	-

Action	Source(s) (continued)
LOCL-IS03	-
LOCL-IS04	-
LOCL-IS05	WCPE, DHMP
LOCL-IS06	OTRG, WCPE
LOCL-IS07	BDSP, DHMP
LOCL-IS08	1154-7, LSP1-14, LSP1-18, LSP1-19, LSPX-3

Mapping & Analysis

Action	Source(s)
LOCL-MA01	0697-3.1, FLP1-2c
LOCL-MA02	WUIP
LOCL-MA03	LSP1-1, LSP1-12, LSPX-2, DHMP

Potential Post-disaster Mitigation Actions

Hazard Management

Action	Source(s)
POST-HM01	1102-7b, 1102-7c
POST-HM02	1102-3a
POST-HM03	1102-5c
POST-HM04	1341-15, 1341-16, 1341-17, 1341-18
POST-HM05	0694-2a

Information/Education

Action	Source(s)
POST-IE01	0697-5.2
POST-IE02	1341-4
POST-IE03	1341-6

Infrastructure

Action	Source(s)
POST-IS01	1341-24

Regulatory

Action	Source(s)
POST-RE01	1177-18

Mapping & Analysis

Action	Source(s)
POST-MA01	1102-16a, 1102-16b, 1102-16c, 1154-13, 1177-17
POST-MA02	1177-18
POST-MA03	1341-5, 1341-11
POST-MA04	1341-10
POST-MA05	1341-25
POST-MA06	0694-1c
POST-MA07	1154-6

Appendix D
State Disaster Declarations, 1976-2000

STATE DISASTER DECLARATIONS 1976-2000				
Year	**Month**	**Type**	**Federal**	**Counties Affected**
1976	June	Dam Failure	X	Bingham, Bonneville, Fremont, Jefferson, Madison
1977	June	Drought	X	Adams, Bear Lake, Blaine, Camas, Caribou, Elmore, Idaho, Lincoln, Washington
1979	January	Flood		Bingham, Washington
	February	Flood		Canyon, Washington
	February	Flood		Nez Perce
	September	Drought		Blaine, Jerome, Lincoln, Minidoka, Oneida, Twin Falls
1980	March	Flood		Power, Oneida
	May	Volcanic Eruption	X	Benewah, Bonner, Boundary, Clearwater, Kootenai, Latah, Nez Perce
1982	February	Flood		Bonner, Washington
	April	Flood		Blaine
	July	Landslide		Boise
1983	June	Flood		Jefferson
	October	Earthquake	X	Butte, Custer, Gooding
1984	January	Flood/Ice Jam	X	Lemhi
	May	Flood		Cassia
	May	Flood		Bannock, Twin Falls
	June	Flood		Jefferson
	June	Flood		Owyhee
	December	Flood		Butte, Lemhi
1985	January	Flood		Cassia
	July	Wildland Fire		State

STATE DISASTER DECLARATIONS 1976-2000 (continued)				
Year	**Month**	**Type**	**Federal**	**Counties Affected**
1985 (cont)	August	Wildland Fire		State
1986	January	Flood		Canyon, Payette, Washington
	February	Flood		Owyhee
	February	Flood, Landslide		Boise
	March	Landslide		Boise, Elmore, Lewis, Nez Perce, Owyhee
	June	Flood		Boise, Custer
	August	Wildland Fire		State
1987	June	Wildland Fire		Ada
	August	Wildland Fire		Bannock
	August	Wildland Fire		Adams
	August	Wildland Fire		State
1989	January	Winter Storm		Bonner, Clark
	July	Wildland Fire		State
1990	September	Dam Fail-ure		Elmore
1991	April	Flood		Bonner
	May	Flash Flood		Bonner
1992	April	Wildland Fire		State
	September	Wildland Fire		State
1993	January	Winter Storm		Jerome
	June	Tornado		Bannock

STATE DISASTER DECLARATIONS 1976-2000 (continued)				
Year	**Month**	**Type**	**Federal**	**Counties Affected**
1994	January	Winter Storm		Elmore
	July	Wildland Fire		State
	December	Flood		North Idaho
1996	February	Winter Storm, Flood	X	Benewah, Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Lewis, Nez Perce, Shoshone
	May	Flood		Payette
	June	Flood		Boundary, Kootenai, Latah, Shoshone
1996 - 1997	November - January	Winter Storm, Flood, Landslide	X	Adams, Benewah, Boise, Bonner, Boundary, Clearwater, Elmore, Gem, Idaho, Kootenai, Latah, Nez Perce, Owyhee, Payette, Shoshone, Valley, Washington
1997	March – June	Flood, Landslide	X	Benewah, Bingham, Bonner, Bonneville, Boundary, Butte, Custer, Fremont, Jefferson, Kootenai, Madison, Shoshone
1998	May	Landslide		Lemhi, Nez Perce, Washington
	October	Landslide		Boundary
2000	June	Landslide		Kootenai
	July	Wildland Fire	X	State
	November	Drought		Bear Lake

Appendix E
Selected Disaster Costs

(as of February 1, 2001)

APPLICANT	CODE	DR-1102 11-Feb-96			
		PA	IA	NRCS	MIT
ADA COUNTY	0001				
ADAMS COUNTY	0002				
BANNOCK COUNTY	0003				
BEAR LAKE COUNTY	0004				
BENEWAH COUNTY	0005	$1,561,440.00		$18,007.11	$731,537.15
BINGHAM COUNTY	0006				
BLAINE COUNTY	0007				
BOISE COUNTY	0008				
BONNER COUNTY	0009	$1,579,788.00		$1,670.00	$20,173.68
BONNEVILLE COUNTY	0010	$0.00			
BOUNDARY COUNTY	0011	$732,851.00		$3,000.00	$3,017.00
BUTTE COUNTY	0012				
CAMAS COUNTY	0013				
CANYON COUNTY	0014				
CARIBOU COUNTY	0015				
CASSIA COUNTY	0016				
CLARK COUNTY	0017				
CLEARWATER COUNTY	0018	$8,395,692.00		$52,888.00	$970,054.30
CUSTER COUNTY	0019				
ELMORE COUNTY	0020				
FRANKLIN COUNTY	0021				
FREMONT COUNTY	0022				
GEM COUNTY	0023				
GOODING COUNTY	0024				
IDAHO COUNTY	0025	$235,329.00			
JEFFERSON COUNTY	0026				
JEROME COUNTY	0027				
KOOTENAI COUNTY	0028	$1,350,509.00	$2,336.00	$14,562.00	$53,045.40
LATAH COUNTY	0029	$2,015,320.00		$86,625.00	$85,736.00
LEMHI COUNTY	0030				
LEWIS COUNTY	0031	$705,173.00		$27,612.00	
LINCOLN COUNTY	0032				
MADISON COUNTY	0033				
MINIDOKA COUNTY	0034				
NEZ PERCE COUNTY	0035	$594,759.00		$60,902.00	$826,913.69
OWYHEE COUNTY	0037				
PAYETTE COUNTY	0038				
POWER COUNTY	0039				
SHOSHONE COUNTY	0040	$2,260,489.00		$35,815.00	$2,164,871.81
TETON COUNTY	0041				
TWIN FALLS COUNTY	0042				
VALLEY COUNTY	0043				
WASHINGTON COUNTY	0044				
STATEWIDE	0099	$2,213,115.93	$22,825.11		$124,740.17
NOT CODED	??	$990,859.00	$46,468.00		$42,264.22
TOTALS		$22,635,324.93	$71,629.11	$301,081.11	$5,022,353.42

APPLICANT	CODE	DR-1154 04-Jan-97				
		PA	IA	NRCS	COE	MIT
ADA COUNTY	0001					
ADAMS COUNTY	0002	$408,906.00		$19,054.54		$622,045.00
BANNOCK COUNTY	0003					
BEAR LAKE COUNTY	0004					
BENEWAH COUNTY	0005	$164,746.00				$32,972.43
BINGHAM COUNTY	0006					
BLAINE COUNTY	0007					
BOISE COUNTY	0008	$2,051,249.00		$9,361.20	$5,361.20	$974,299.39
BONNER COUNTY	0009	$2,547,126.00				
BONNEVILLE COUNTY	0010					$425,609.00
BOUNDARY COUNTY	0011	$1,344,509.00				
BUTTE COUNTY	0012					
CAMAS COUNTY	0013	$10,537.00				
CANYON COUNTY	0014					
CARIBOU COUNTY	0015					$7,784.00
CASSIA COUNTY	0016					
CLARK COUNTY	0017					
CLEARWATER COUNTY	0018	$1,256,639.00				
CUSTER COUNTY	0019					
ELMORE COUNTY	0020	$183,704.00				
FRANKLIN COUNTY	0021					
FREMONT COUNTY	0022					
GEM COUNTY	0023	$731,318.00		$26,420.63	$90,786.00	$2,495.00
GOODING COUNTY	0024					
IDAHO COUNTY	0025	$695,115.00		$13,531.85		
JEFFERSON COUNTY	0026					
JEROME COUNTY	0027					
KOOTENAI COUNTY	0028	$2,889,021.00				$23,550.25
LATAH COUNTY	0029	$205,217.00		$7,588.54		$70,461.00
LEMHI COUNTY	0030					
LEWIS COUNTY	0031					
LINCOLN COUNTY	0032					
MADISON COUNTY	0033					
MINIDOKA COUNTY	0034					
NEZ PERCE COUNTY	0035	$673,467.00		$18,322.00		
OWYHEE COUNTY	0037	$90,152.00				
PAYETTE COUNTY	0038	$914,809.00	$6,000.00	$16,635.38	$27,059.78	
POWER COUNTY	0039					
SHOSHONE COUNTY	0040	$339,935.00				$2,345,596.85
TETON COUNTY	0041					
TWIN FALLS COUNTY	0042					
VALLEY COUNTY	0043	$144,946.00				
WASHINGTON COUNTY	0044	$3,263,867.00	$5,400.00	$15,022.76	$255,069.10	
STATEWIDE	0099	$1,453,038.93	$28,587.86		$186,300.00	$1,088,108.30
NOT CODED	??	$35,803.27			$11,738.10	$970.40
TOTALS		$19,404,105.2	$39,987.86	$125,936.90	$576,314.18	$5,593,891.62

APPLICANT	CODE	DR-1177 12-Jun-97			
		PA	IA	NRCS	MIT
ADA COUNTY	0001				
ADAMS COUNTY	0002				
BANNOCK COUNTY	0003				
BEAR LAKE COUNTY	0004				
BENEWAH COUNTY	0005	$225,750.00		$24,139.23	
BINGHAM COUNTY	0006	$2,215,444.00	$400.00	$88,144.08	$179,228.53
BLAINE COUNTY	0007				
BOISE COUNTY	0008				$7,102.32
BONNER COUNTY	0009	$556,676.00		$47,921.70	
BONNEVILLE COUNTY	0010	$545,827.00		$23,115.05	
BOUNDARY COUNTY	0011	$810,109.00		$36,043.79	
BUTTE COUNTY	0012	$66,693.00			
CAMAS COUNTY	0013				
CANYON COUNTY	0014				
CARIBOU COUNTY	0015				
CASSIA COUNTY	0016				
CLARK COUNTY	0017				
CLEARWATER COUNTY	0018	$0.00			$23,000.00
CUSTER COUNTY	0019	$327,358.00			
ELMORE COUNTY	0020				
FRANKLIN COUNTY	0021				
FREMONT COUNTY	0022	$20,060.00			
GEM COUNTY	0023				
GOODING COUNTY	0024				
IDAHO COUNTY	0025				
JEFFERSON COUNTY	0026	$1,132,767.00	$600.00		
JEROME COUNTY	0027				
KOOTENAI COUNTY	0028	$184,513.00			$939,868.38
LATAH COUNTY	0029	$0.00			
LEMHI COUNTY	0030				
LEWIS COUNTY	0031				
LINCOLN COUNTY	0032				
MADISON COUNTY	0033	$398,841.00			
MINIDOKA COUNTY	0034				
NEZ PERCE COUNTY	0035				
OWYHEE COUNTY	0037				
PAYETTE COUNTY	0038				
POWER COUNTY	0039				
SHOSHONE COUNTY	0040	$3,072,636.82			$455,237.16
TETON COUNTY	0041				
TWIN FALLS COUNTY	0042				
VALLEY COUNTY	0043				
WASHINGTON COUNTY	0044				
STATEWIDE	0099	$1,734,366.23	$7,054.10	$31,690.42	$86,884.06
NOT CODED	??	$74,626.00			$137.38
TOTALS		$11,365,667.05	$8,054.10	$251,054.27	$1,691,457.83

Appendix F
Local Mitigation Plan Status

(as of June 8, 2001)

As of December, 2000, four counties have formed Mitigation Planning committees and an additional ten have active Local Emergency Planning committees. Five counties have completed FMA plans, although one is pending approval by FEMA. Two counties (Kootenai and Shoshone) have completed comprehensive flood hazard mitigation plans and one (Caribou) may have completed an all-hazard mitigation plan.

County	Committee	Workshop	FMA	Flood	All Hazard	Other	Comments
Ada							
Adams							
Bannock	LEPC						
Bear Lake	LEPC						
Benewah							
Bingham	LEPC						
Blaine	LEPC						
Boise							
Bonner							
Bonneville							
Boundary							
Butte							
Camas							
Canyon							
Caribou					?		
Cassia							
Clark							
Clearwater			Y				
Custer	LEPC						
Elmore							
Franklin	LEPC						
Fremont	LEPC						
Gem							
Gooding							
Idaho							
Jefferson							
Jerome							
Kootenai	LEPC		Y	5/98			
Latah	LEPC						
Lemhi							
Lewis	Mit Plan		Y				Not yet approved by FEMA.
Lincoln							
Madison	Mit Plan						
Minidoka							
Nez Perce	LEPC						
Oneida							
Owyhee							
Payette	Mit Plan		Y				
Power							
Shoshone	Mit Plan		Y	10/00			
Teton							
Twin Falls							
Valley							
Washington							

Appendix G
Hazard Mitigation Grant Program Projects

(February 1, 2001)

DR-1102: Northern Idaho Flooding (2/96)			
Applicant and Project Name	**Project Description**	**Grant Amount**	**Status**
Benewah County: St. Joe Park Elevations	Elevate 6 homes.	$15,450.00	CLOSED
Benewah County: Meadowhurst Home Elevation	Elevate thirteen (13) homes above base flood elevation.	$238,624.00	CLOSED
Benewah County: Riverdale Home Elevation	Elevate sixteen (16) homes above base flood elevation.	$258,706.00	CLOSED
Boundary County: Restorium Retaining Wall	Construction of a 40' retaining wall. 4' high x 8" wide.	$3,075.00	CLOSED
City of Bovil: Main Drainage Channel	Channel construction; roadway, ditch, and culvert construction at 9 locations.	$36,391.00	CLOSED
City of Bovil: Drainage Channel #3	Installation of 400' of 36" CMP to replace undersized culverts.	$16,848.00	CLOSED
City of Mullan: Mill Creek	Installation of a catch basin and 4,000 feet of 48" pipe running underneath Second Street.	$390,098.00	CLOSED
City of Orofino: Michigan Avenue	Acquisition of 4 homes, one church and relocation of 1 home.	$283,919.00	CLOSED
City Of St. Maries: Sewer Ponds	Raise sewer pond berms by four feet	$216,095.00	CLOSED
City of St. Maries: Cherry Creek Control	Installation of a sluice gate into an existing culvert to prevent backflow into Cherry Creek.	$28,192.00	CLOSED
City of Tensed: 3rd Street Sanitation Site	Upgrade culverts to city sewer treatment site.	$3,508.00	CLOSED
Clearwater County: Noah's Bridge	Structural upgrade of bridge	$150,000.00	OPEN
Kootenai County: Cochran Home Relocation	Relocation of 1 mobile home.	$9,500.00	CLOSED
Kootenai County: Hayden Lake Spillway	Installation of a 50 foot concrete emergency spillway on the existing dike.	$42,000.00	CLOSED
Milo Creek Project Team: Milo Creek Acquisition	Acquisition of 1 property	$117,096.00	CLOSED
Nez Perce County: Big Canyon Creek	Acquisition of flooded homes; channel stabilization ; and retention ponds.	$830,344.00	CLOSED
Shoshone County: Riverview Drive Acquisition	Acquisition and removal of 9 homes.	$282,650.00	CLOSED
Shoshone County: Bumble Bee Acquisition	Acquisition and removal of 4 homes.	$181,426.00	CLOSED
Shoshone County: Enaville Acquisition	Acquisition and removal of 5 homes.	$438,620.00	CLOSED
Shoshone County: CDA River Acquisition	Acquisition and removal of 1 home.	$68,211.00	CLOSED
Shoshone County: Palo Road	Acquisition and removal of 1 home. Elevation of 1 home.	$97,896.00	CLOSED
University of Idaho: Storm Sewer Backflow	Installation of backflow prevention valves in storm drain outfalls.	$30,000.00	CLOSED

DR-1154: Idaho Heavy Snow, Landslides, and Floods (11/96 – 1/97)			
Applicant and Project Name	**Project Description**	**Grant Amount**	
Adams County: Pinehurst Acquisition	Acquisition of 1 home.	$210,800.00	
Boise County: Lower Banks Acquisition	Acquisition of five homes and/or businesses.	$1,083,630.00	
Bureau Of Disaster Services & USGS: Flood Frequency & Magnitude	Computer estimations of flood frequency and magnitude throughout the state. Web Site	$134,000.00	
City Of Idaho Falls: 8th St. Storm detention Pond.	Construction of a storm retention pond, with piping and lift station.	$293,000.00	
City Of Idaho Falls: 14th Street Storm Detention Pond	Construct detention pond.	$212,000.00	
City of Idaho Falls: IF High School Pond	Storm detention pond and related piping system.	$425,609.00	
City of Mullan: Faye Street	Recribbing a road bank.	$56,180.00	
City of Tensed: 3rd St. Sanitation Site	Upgrade culverts on access road to city waste transfer station and sewer treatment site.	$24,827.00	
East Side Highway District: East Side Culvert / French	Install 2 Four-foot culverts, raise elevation, clean stream channel.	$22,865.00	
Latah County: Deep Creek Stream Stabilization	Stream Stabilization of Deep Creek to protect impinged dike toe.	$18,050.00	
Milo Creek Project Team: Milo Creek	Construction of Sediment control System and installation of two 60" reinforced concrete pipes.	$2,288,228.00	
North Gem School District: Smoke Stack	Removal of the Smoke Stack at the high school	$11,000.00	
Palouse-Clearwater Environmental Institute: Paradise Creek	Restoration of natural channel with stream bank stabilization.	$50,360.00	
Shoshone County: Data Collection Point	Purchase upgrades to stream flow data collection.	$2,500.00	

DR-1177: Southeast Idaho Floods (3/97)			
Applicant and Project Name	**Project Description**	**Grant Amount**	**Status**
Bingham County: County Mitigation	Construction of secondary Irrigation gates, headgates and pipes.	$200,335	CLOSED
Coeur D'Alene School District: Non-Structural Seismic Retrofits	Non-Structural Seismic retrofits of several of the school district's facilities.	$233,790	CLOSED
Garden Valley School District: Non-Structural Seismic Retrofits	Non-Structural Seismic retrofits of several of the school district's facilities.	$9,790	DELAYED
Idaho Dept. of Lands: Wildland-Urban Interface Fire Education Conference	Conference to inform homeowners of the dangers, consequences, and correction policy needed to maintain a safe interface.	$35,000	COMPLETE
Idaho Dept. of Lands: Wildland-Urban Interface Fire Education Conference II	Conference to inform homeowners of the dangers, consequences, and correction policy needed to maintain a safe interface.	$18,000	COMPLETE
Boise City: Boise River Stabilization	Installation of river barbs	$62,500	OPEN
Kootenai County: Ingalls Elevation	Elevation of 1 home.	$32,932	CLOSED
Kootenai County: Cataldo Acquisition	Buyout of up to 25 homes.	$1,074,466	7 homes purchased
Shoshone County: Erickson Acquisition	Acquisition and removal of 1 home.	$44,000	CLOSED
Inter-Agency Drainage Task Force (BDS, USGS, BLM, National Weather Service): Drainage Monitors	Purchase, installation and upgrade of drainage monitors	$99,800	2 monitors installed

Appendix H
Shoshone County Mitigation Plan

(edited for inclusion in this document)

Preparation of this plan was supported by a grant from the Idaho Bureau of Disaster Services.

ACKNOWLEDGEMENTS

The development of this plan would not have been possible without the dedicated efforts of the staff of Shoshone County. Thanks are in order for Bill Scott of Disaster Services and Kenny Hicks, Planning and Zoning Administrator. Special thanks to Lori Jamieson, the Flood Plain Administrator, for managing the project, insuring that spaces for meetings were scheduled, distributing materials and making the job of putting the plan together a pleasant experience for everyone.

Special recognition is in order for the Shoshone County Flood Mitigation Committee who are listed below. They provided the vital link between the citizens of the county and the county staff and consultant team.

Shoshone County Flood Mitigation Committee

Verne Blalack
Harry Cougher
Pat Chemodurow
Sally Hall
Melissa Sheffelmaier
Bruce Van Broeke
Jim Boyd
Pat Allen
Kenny Hicks
Bill Scott
Lori Jamieson
Richard & Connie Guiterrez
Dale Costa
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INTRODUCTION

Floods have been a common occurrence since the beginning of pioneer settlement in the Silver Valley of Shoshone County in the late 19th Century and are the most common natural disaster. Many of the floods have been very destructive including those in 1933, 1974 and recently in 1996 and 1997. People's lives were in danger. Some people lost their homes. There was extensive damage to public roads and facilities. County services were stressed to the maximum.

Floods are a natural phenomenon, and while they cannot be avoided, thoughtful planning and preparation can reduce the damages that occur from flooding. The purpose of this flood mitigation plan is to reduce flood damage in Shoshone County by taking appropriate action before, during and after a flood occurs. The plan describes the nature of flooding in Shoshone County, specifies actions to be taken to reduce flood damage and identifies possible sources of funding for these actions. Consequently, this plan should assist in reducing the cost of flood insurance for county residents.

The plan contains five sections. The first is a summary of the flood goals and mitigation actions and serves as quick overview. The second section describes the process used to arrive at this plan. The third section describes more thoroughly the flood mitigation goals and actions. This section is followed by the technical data that support these goals and actions. Finally, there are several appendices that include technical data, data discovered during the community participation phase of the process and maps of the floodprone areas.

Plans are only as effective as those responsible for the completion. Community participation was an integral part of this planning process giving everyone the opportunity to participate. County officials are charged with the responsibility for executing the plan; however, it is the ultimate responsibility of all citizens to take appropriate actions to reduce flood losses. This plan provides the guidance. It is up to the citizens of Shoshone County to follow through. This plan is a living document. As actions are completed, new ones will evolve. Thus, the plan should be reviewed and revised as necessary to provide continuous and ongoing guidance for flood mitigation.

SUMMARY OF FLOOD MITIGATION

GOALS AND ACTIONS

Listed below is a summary of Shoshone County's flood mitigation goals and actions that evolved from community participation and the accompanying technical information. This summary is provided as a quick reference to the detailed statements appearing later in the plan. The symbol that precedes each of the actions identifies the time frame for completion of that activity: short-range ❶, medium-range ❷ or long-range ❸. Short-range actions should be accomplished within a year, medium-range within 1 to 5 years, and long-range 5 or more years. Some actions may also be ongoing without regard to assigned time range.

FLOOD MITIGATION GOALS

Sustain Shoshone County's capability to deal quickly, efficiently and effectively with flash flooding, seasonal flooding and major flood events.

Provide ongoing maintenance of streambeds and flood control structures to reduce the impact of future flood events on public and private property.

Require future public facilities and improvements to be designed, located and maintained to mitigate flooding.

Ensure that public information on flood mitigation and emergency measures is clear, easy to understand and timely.

Foster constructive communication and cooperation for flood mitigation, response and recovery actions with the communities of Shoshone County, Benewah and Kootenai Counties, and other bordering counties and state and federal agencies.

Support flood mitigation planning and watershed management projects that can reduce the effects and costs of future floods.

FLOOD ACTIONS

Prevention

Preventative activities keep flood problems form getting worse

❶***Establish a permanent flood mitigation committee comprised of county staff and citizens representing the floodprone areas of the county charged with the responsibility of implementing, reviewing and updating the flood mitigation plan.***

❶***Establish a countywide program for removing bed loading in all streams <u>where and when possible.</u>***

❶***Provide continuing support for the position of Shoshone County Floodplain Administrator to assure compliance with local, state and federal rules and responsibilities.***

❶***Enforce existing county land development and building regulations in floodplains and floodways.***

❶***Add, under the duties of the Floodplain Administrator, a section to Shoshone County Floodplain Ordinance directing the Floodplain Administrator to insure construction proceeds in conformance with an approved plan by doing field checks on: a) development location prior to start of construction with a site plan and b) first floor elevations requirements with a final elevation certificate before framing inspection.***

❶ ***Establish a fee to administer the review and evaluation of floodplain development permits and field inspection of development in progress to ensure performance with approved plans.***

❶***Initiate an annual flood clean-up day to coordinate voluntary dike, tree, stream bank, and stream clean-up efforts.***

❶***Add a section to the County's Floodplain Ordinance requiring securing or removal of possible items that could migrate downstream (i.e., propane tanks, picnic tables, portable outhouses, hazardous materials, and barbecues) from floodplains during a designated flood period, November 14 through May 16.***

❸ ***Add new river gauges to increase the effectiveness of early flood warning methods.***

❷***Examine the potential for culverts and bridges to create flood hazards and then establish a program to clean culverts or change their sizes and improve bridge clearances to avoid flood hazards.***

❶***Request the Federal Emergency Management Agency to reevaluate current flood zones and prepare new flood insurance maps.***

❷***Identify and map the locations of the storage of petroleum products, gas lines, and other hazardous material sites in or adjacent to flood zones.***

❷***Set up and maintain a comprehensive data base that identifies flood prone locations on county roads, structures in floodplains, roads needed by emergency vehicles and school bus routes to quickly indicate priorities for evacuation during a disaster and to mediate hazards prior to flood events.***

Property Protection

Property protection activities are undertaken by private property owners to reduce the emotional and financial stress of flooding. Public entities pursue property protection activities for public safety purposes and to reduce the public cost of flood damages.

❶***Require flood-proofing measures in the design and construction of all public projects in Shoshone County such as roads, public water supplies, wastewater treatment facilities, parks facilities and rails-to-trails paths.***

❶***Offer a <u>voluntary</u> program for acquisition, relocation or flood proofing for floodplain residents or businesses that wish to relocate out of the floodplain or flood proof their homes and businesses with priority given to those properties with a history of repetitive losses.***

❷***Conduct inter and intradepartmental reviews of relocation/buyouts and prepare a report to provide the Shoshone County Board of County Commissioners adequate information for decisions.***

❶***Amend the Shoshone County Floodplain Ordinance to require that floodway and floodplain boundaries be delineated on all survey maps and a base flood elevation be established in Zone A's.***

Natural Resource Protection

Natural resource protection activities deal with measures to protect, preserve or restore natural floodplain activities.

❶***Support public and private best management practices that promote stream bank stabilization efforts on rivers and tributary creeks and maintenance of vegetation or revegetation of slopes adjacent to floodplains.***

Emergency Services

Emergency measures are taken during the flood to minimize the impact of flood events on people and property.

❷***Invite the elected leadership of Benewah County to develop, annually review and update as needed a protocol with Shoshone County that addresses joint flooding issues such as warning, access and emergency communications on the St. Joe River.***

❷ ***Have the Shoshone County Emergency Services Coordinator work on joint emergency management flooding issues on the Coeur d'Alene and St. Joe Rivers with other county coordinators and the North Idaho Bureau of Disaster Services Area Field Office on an ongoing basis.***

❶***Preplan and check early warning systems to be sure that emergency service equipment is available on both sides of all rivers.***

❶***Revise and update the Shoshone County Emergency Operations Plan.***

❷***Develop and maintain, in cooperation with citizens, neighbor-to-neighbor community based emergency plans to deal with local flood warnings and emergency supply needs as a supplement to the overall countywide emergency operations plan.***

❶ ***Establish and maintain a Special Revenue Fund in the Shoshone County budget to be used exclusively for leveraging matching funds for disaster mitigation and response***.

Structural

Structural projects are associated with public infrastructure and flood control facilities such as dikes and levees.

❷***Prioritize and complete improvements and or repairs to flood damaged county roads and bridges.***

❷***Work with the Corps of Engineers to review the condition of all dikes, develop programs to repair damaged dikes, maintain existing dikes and suggest the creation of dike districts.***

❷***Identify tributary creeks in gulches along the South Fork of the Coeur d'Alene River that impact unincorporated communities and incorporated and meet with appropriate city and other local officials to discuss joint solutions, identify funding sources for maintenance and repair of existing control measures and develop new measures.***

❶***Support the scheduling of the repair of the erosion control measures along the South Fork of the Coeur d'Alene River to protect the Shoshone County Public Safety Facility from future flooding.***

Public Information

Public information activities provide citizens, businesses and visitors facts about flood hazards, ways to protect people and property and the benefits of floodplain management.

❶***Identify and publicize alternative routes into and out of populated areas susceptible to road closures during flooding.***

❶***Be sure signs at detour roads are specific and easy to read and understand.***

❶***Conduct an annual workshop to listen to people's concerns, communicate floodplain rules and provide information on potable water, food, sandbags, and first aid to assist citizens to prepare for floods in the Coeur d'Alene and St. Joe River Valleys.***

❶***Encourage individual responsibility and self-help during flooding events by providing an annual notice to residents in utility bills reminding them of flood hazards and the need for an adequate supply of food, potable water, a first aid kit and sandbags.***

❶***Place signs at county lines which read: Building Codes and Floodplain Ordinances Enforced.***

❶***Prepare a pamphlet <u>specifically</u> for Shoshone County residents and businesses that explains the Flood Insurance Rate Maps and the map legend in terms that people can easily understand and relate to their property.***

❶ ***Make publications available at County offices and public libraries which teach people how to prepare for floods.***

❷***Make Shoshone County floodplain regulations and information on obtaining necessary permits for activities in the floodplain available on the Internet when the county develops a home page.***

THE PLANNING PROCESS

Shoshone County received a flood mitigation planning grant from the Idaho Bureau of Disaster Services. A request for proposal was issued in early 2000, and Fred A. Hurand, FAICP, Planning Consultant, and his planning team, Abby Byrne and Rose Morgan, were hired to assist the County Floodplain Administrator, County Emergency Services Director and County Planning Administrator in the development of this plan.

The consultant team began working with the county staff in March of 2000. The consultant team met with county staff and two members of the Board of County Commissioners to review a work program and set a schedule for the completion of the plan. To accommodate a more extensive citizen participation program, the county agreed to extend the work program to the end of the summer of 2000.

A Flood Mitigation Committee was appointed to assist the consultant and the county in the development of the plan. This committee consisted of members of the county staff, citizens affected by flooding in the county, state and other local officials. They provided insight into the major flood issues, assisted with the community participation program, crafted the flood goals and action statements and reviewed the plan.

The consultant team met with county personnel and the Flood Mitigation Committee on the evening of April 5 to review the project work program and prepare for upcoming citizen participation activities. The committee first reviewed maps of the floodprone areas of Shoshone County and noted locations of specific flood problems along both forks of the Coeur d'Alene River and the St. Joe River. The committee then approved a set of community participation guidelines and a participation program. Dates were set for a series of sub-area open houses and workshops, three in the Coeur d'Alene River basin at Wallace, Kellogg and Pinehurst and one at the St. Joe Lodge along the St. Joe River.

Within the next two weeks, the committee received results of this meeting along with posters announcing the sub-area workshops and a set of comment sheets to distribute to their neighbors. These comment sheets could be returned to the Floodplain Administrator or to the committee member. The sheets were also made available at the subsequent sub-area workshops and open houses. Appendix A contains a record of the results of these comment sheets. News releases announcing the open houses and workshops were also distributed to local media.

The open house/workshops were held on May 1, 4, 8 and 9. On each of these dates an open house was held from 4:00 to 6:00 PM followed by a workshop from 7:00 to 9:00 PM. The open houses allowed participants to drop in and chat with the consultant team and county staff. The workshops were more formal. Both were designed to collect information about flood problems and allow participants to suggest solutions to these problems. Again maps were used to focus discussion about problems with each participant given the opportunity to identify the location of the problem as well as define it. Solutions were discussed in small groups and later presented to the whole group.

Before leaving the meeting, participants were informed of a series of subsequent meetings to be held in mid-June.

The consultant team then compiled the information obtained at these open house/workshops and distributed it to the Flood Mitigation Committee. To broaden the scope of problem setting, comment sheets were distributed to 39 local, state and federal agencies and community organizations. The consultant team then prepared a draft set of flood mitigation goals and actions based upon the problems and solutions obtained during the open house/workshops for review at the next Flood Mitigation Committee meeting.

A second Flood Mitigation Committee meeting was held on May 22. The committee reviewed and revised the draft goals prepared by the consultant team. In small groups, the committee then reviewed the draft action statements. Some statements were modified, some were deleted and new statements were added. The committee then agreed upon the location of the next participation activity, a series of community listening posts at locations along the North and South Forks of the Coeur d'Alene River and on the St. Joe River.

Following this meeting, the consultant team reviewed the list of action statements and selected a subset for use in the subsequent listening posts. This smaller list contained 26 items on the committee's list. The list was placed on a checklist form to be distributed at the listening post. The checklist asked citizens to select 8 of the 25 actions statements that they felt were most important. Each committee member also received several checklists each to distribute to friends and neighbors.

The listening posts were held the week of June 12 through 17. On Monday, June 12 the consultant team and County Floodplain Administrator met with citizens at the Spragpole in Murray in the early afternoon and at Barney's grocery store in Pinehurst in the late afternoon. On the following Tuesday, the same team visited with citizens at the Calder Post Office at noon and the St. Joe Lodge in the late afternoon. The Emergency Services Director also participated in several of these listening posts. On Saturday, the consultant team and the Planning Administrator attended Gyro Days in Mullan and Wallace. Citizens were asked to discuss flood issues with the team and complete a checklist.

The consultant team then compiled the results of the listening posts, distributed them to the Flood Mitigation Committee and met with them on June 26th. At this meeting the committee reviewed the results of the listening posts and then revised, deleted and added to their actions statements. The committee then set August 28 for public review of the draft mitigation plan.

Concurrent with the participation process, the consultant team collected and compiled the technical data about flooding in Shoshone County. This included climate information, flood history, damage estimates and other important data. This information along with that gathered during the participation process was combined to form the draft mitigation plan. This plan was distributed to the Flood Mitigation Committee and placed in libraries and other strategic locations for public review along with comment sheets that could be

returned to the Floodplain Administrator. These drafts were available from August 7 to the day of the public meeting.

A public meeting was held at the Sunnyside Elementary School in Kellogg on the evening of August 28. Citizens and the Flood Mitigation Committee reviewed the plan. Comments on the content were taken and suggestions were made for changes to the plan. The Flood Mitigation Committee met immediately after the public meeting to approve any suggested changes. This was the last formal meeting of the committee. The consultant was then charged with the responsibility for making the suggested changes to the plan. The plan was then delivered to the county staff in the second week of September.

FLOOD MITIGATION ACTION PLAN

The flood mitigation planning process resulted in the creation of the following action plan. The plan is a blueprint for reducing damages caused by future floods in Shoshone County. These are practical actions designed to fit both the nature of flooding in the county and the county's abilities to achieve these actions.

This action plan also recognizes that Shoshone County government revenues reflect the realities of a county with a small amount of taxable private land, approximately 18%, declining population and an economy in transition from a natural resources base. In addition, demand for county services is increasing rapidly with the expansion of recreational development along rivers and streams. These factors make unexpected events such as the floods of 1996 and 1997 place considerable strain on county resources. Some needed assistance during the flooding and for disaster recovery was provided through federal and state grants; however, a careful review of county revenues and expenditures indicates there is limited money available for activities such as flood mitigation projects.

Because of the reality of local government finances, funding for action steps has been identified giving priority to grants and low-interest loan programs. It is also necessary to recognize that the county must show a good faith effort by allocating some revenue for flood mitigation actions. The amount need not be large, but without some local government commitment outside funding will be difficult to obtain. Other funding sources found in this plan are for programs available to private property owners. Programs to address financing facilities that benefit a particular geographic area of the county such as Flood Control Districts authorized in Idaho Code: Title 42, Chapter 31.42.3101 are recommended as the most equitable way to deal with localized issues.

It is equally important to recognize that resources to carry out flood mitigation plan goals and actions steps do not depend exclusively on money. There are action steps that are policy choices that must be made by the Shoshone Board of County Commissioners such as requesting the National Flood Insurance Program flood insurance maps be updated. Other policy choices emphasize cooperation with other entities such as improved communication between elected officials in cities and adjacent counties. This takes a consistent long-term effort and sometimes requires difficult political choices.

Finally, volunteer activities and in-kind matches to bring in outside dollars should neither be overlooked nor underestimated. For example, voluntary community clean-up efforts offer important benefits at no cost to the county. Providing in-kind matches such as keeping track of volunteer hours spent on flood mitigation activities takes only a small amount of record keeping at little cost. For a minimal amount of administrative activity, the returns in winning grant dollars for mitigation projects are an excellent trade off.

The plan begins with the flood mitigation goals set by the Flood Mitigation Plan Committee. These goals are the foundation for the set of actions described below. The action statements follow and are organized by the six action categories established by the Federal Emergency

Management Agency. The symbol that precedes each of the actions identifies the time frame for completion of that activity: short-range ❶, medium-range ❷ or long-range ❸. Short-range actions should be accomplished within a year, medium-range within 1 to 5 years, and long-range 5 or more years. Some actions may also be ongoing without regard to assigned time range.

Each action or group of similar actions is followed by an explanatory paragraph. The agency or group responsible for completing the action is identified. Then a time frame for completion and possible funding sources for the action are also noted.

FLOOD MITIGATION GOALS

Sustain Shoshone County's capability to deal quickly, efficiently and effectively with flash flooding, seasonal flooding and major flood events.

Provide ongoing maintenance of streambeds and flood control structures to reduce the impact of future flood events on public and private property.

Require future public facilities and improvements to be designed, located and maintained to mitigate flooding.

Ensure that public information on flood mitigation and emergency measures is clear, easy to understand and timely.

Foster constructive communication and cooperation for flood mitigation, response and recovery actions with the communities of Shoshone County, Benewah and Kootenai Counties, and other bordering counties and state and federal agencies.

Support flood mitigation planning and watershed management projects that can reduce the effects and costs of future floods.

FLOOD ACTIONS

Prevention

❶Establish a permanent flood mitigation committee comprised of county staff and citizens representing the floodprone areas of the county charged with the responsibility of implementing, reviewing and updating the flood mitigation plan.

At the last meeting of the Flood Mitigation Committee, members suggested that a permanent committee be established to help implement the plan. They

also suggested that members of this committee include appropriate county staff and that extraordinary effort be made to include citizens from all of the floodprone areas of the county.

Who: Board of County Commissioners for appointing members, county staff, appointed citizens.
When: Within the first year after the adoption of the plan.
Resources: None needed.

❶***Establish a countywide program for removing bed loading in all streams <u>where and when possible.</u>***

This was the action statement given the highest priority by citizens involved in the planning process. Upland forest and development practices and the vigorousness of flow of streams and rivers in the county create serious deposition in all the rivers in the county. This deposition changes the course of these streams, forces water onto property not previously affected and widens the floodplain. Although environmental regulations prohibit extensive manipulation of the streambeds, there are techniques to create catchment areas and structures for removing deposition that can be environmentally sound and still achieve some moderation in the effects of stream changes. These techniques should be applied to all streams that contribute to flooding within the county.

Who: County public works staff, flood control district staff or volunteers and Corps of Engineers.
When: Within two years of the adoption of the plan.
Resources: Corps of Engineers: Channel clearing for flood prevention program, county budget, and flood control district budgets.

❶***Provide continuing support for the position of Shoshone County Floodplain Administrator to assure compliance with local, state and federal rules and responsibilities.***

❶***Enforce existing county land development and building regulations in floodplains and floodways.***

❶***Add, under the duties of the Floodplain Administrator, a section to Shoshone County Floodplain Ordinance directing the Floodplain Administrator to insure construction proceeds in conformance with an approved plan by doing field checks on: a) development location prior to start of construction with a site plan and b) first floor elevations requirements with a final elevation certificate before framing inspection.***

These three action items address changes in floodplain permit administration. The current development permitting process is adequate but needs to be improved and publicly supported by the County Commissioners and county staff. Enforcement of county, state and federal regulations insures that flood damage is minimized. It also is important for maintaining the county's participation in the Federal Emergency Management Agency's (FEMA's) National

Flood Insurance Program which supports private insurance at affordable rates for property owners in floodplains.

Who: County Commissioners, sheriff or designated representative, with assistance from County Floodplain and Planning administrators for enforcement, County Floodplain Administrator and all staff of the county and the public in general.
When: This should happen immediately and be continuous.
Resources: The county budget, floodplain permit fees, enforcement fines.

❶ ***Establish a fee to administer the review and evaluation of floodplain development permits and field inspection of development in progress to ensure performance with approved plans.***

A fee for reviewing floodplain development permits and conducting field inspections will cover the costs of permit administration that benefit services provided to individual permit applicants. Charging a fee to cover the cost of providing services to administer land development permits is a standard approach well established in local government budgeting. As a protection for citizens and business applicants this fee can not, by law, be used to raise revenue.

Who: Board of County Commissioners
When: Not later than one year after the adoption of the plan.
Resources: None needed, policy action.

❶***Initiate an annual flood clean-up day to coordinate voluntary dike, tree, stream bank, and stream clean-up efforts.***

The lack of continuous and effective dike and stream bank maintenance has exacerbated flooding in several parts of the county. Recent efforts have helped to improve these facilities. These efforts should continue with an annual event that helps remind people of floods and improves the condition of the stream banks to include the removal of potentially hazardous trees. The county can look to partners such as cities and the private sector to act as co-sponsors.

Who: Floodplain Administrator and other county staff and volunteers from the community who are affected by flooding.
When: Within a year of the adoption of the plan and ongoing thereafter.
Resources: County equipment and staff and volunteers, business sponsors.

❶***Add a section to the County's Floodplain Ordinance requiring securing or removal of possible items that could migrate downstream (i.e., propane tanks, picnic tables, portable outhouses, hazardous materials, and barbecues) from floodplains during a designated flood period, November 14 through May 16.***

These types of materials are a constant threat as they are lifted from recreational vehicle and second home sites during floods and float downstream and contaminate floodwaters. Containing or removing these items would reduce the threat to neighbors, structures and those involved in flood fighting and emergency services.

Who: Board of County Commissioners.
When: Within one year of the adoption of the plan.
Resources: None needed, policy action.

❸ ***Add new river gauges to increase the effectiveness of early flood warning methods.***

The United States Geologic Survey (USGS) water monitoring gauges along the major rivers in Shoshone County are just adequate. More gauges upstream would help to avoid late responses to flooding giving most residents and the county staff time to prepare for the flood emergency.

Who: County and state in cooperation with federal agencies.
When: Within 5 to 10 years
Resources: USGS, National Resources Conservation Service (NRCS)

❷***Examine the potential for culverts and bridges to create flood hazards and then establish a program to clean culverts or change their sizes and improve bridge clearances to avoid flood hazards.***

The failure of the Milo Creek culvert system and the culverts in other locations in the county exacerbated flooding in many areas. Similarly, some residents claim that bridge clearances have prevented debris and water from floating downstream. A thorough examination of the potential for these culverts and bridges to cause additional flooding would help to either clear the air about their effectiveness or identify those that need replacing or cleaning. In addition, a volunteer "Adopt a Culvert" program, similar to roadside litter programs, could assist in preventing problems. A "planning only" grant is recommended to bring in outside expertise to help develop the practical procedures to set-up and implement this program on an ongoing basis.

Who: Shoshone County Public Works Department, Clarkia Highway District
When: Within five years of the adoption of the plan and ongoing thereafter.
Resources: Idaho Bureau of Disaster Services Hazard Mitigation Grant Program (IHMGP), County Road Fund, Clarkia Highway District Budget, Community Development Block Grant, planning only, volunteers.

❶***Request the Federal Emergency Management Agency to reevaluate current flood zones and prepare new flood insurance maps.***

FEMA's flood insurance maps may be outdated and inaccurate given the changing conditions in and near the rivers and streams of Shoshone County. By pooling resources with the towns

and cities in the county and encouraging the creation of a Cooperating Technical Community, the county may be able to get assistance for expediting the review and update of the county's flood insurance maps.

Who: County Commissioners, county public works, emergency services and planning staff, elected officials and staffs of communities in the county, FEMA.
When: Commencing as soon as possible and extending from five to ten years.
Resources: County budget and FEMA.

❷Identify and map the locations of the storage of petroleum products, gas lines, and other hazardous material sites in or adjacent to flood zones.

❷Set up and maintain a comprehensive data base that identifies floodprone locations on county roads, structures in floodplains, roads needed by emergency vehicles and school bus routes to quickly indicate priorities for evacuation during a disaster and to mediate hazards prior to flood events.

A comprehensive data based is necessary for the county to be effective in implementing flood mitigation policies. For example, there is no existing current land use survey to aid in compiling a Hazard Inventory. This is especially necessary given the high potential for contamination from mining activities and the Superfund sites. Other advantages include quick identification of detour routes to aid emergency response and locations of problem roads and bridges. Once a data based is established tracking development in floodplains, reoccurring flooding problems and fiscal information can be kept current. One possible source for beginning this process is the FEMA Q3 digital data project that provides the beginnings of a digital mapping system that can serve to augment any database.

Who: Board of County Commissioners, Public Works Department, Emergency Services Director and County Floodplain and Planning Administrators.
When: Within two years of the adoption of the plan.
Resources: County revenues, IHMGP, donations.

Property Protection

❶Require flood-proofing measures in the design and construction of all public projects in Shoshone County such as roads, public water supplies, wastewater treatment facilities, parks facilities and rails-to-trails paths.

The county roads and infrastructure were the most heavily damaged public facilities during the past several floods. In addition, many of public as well as private water sources were

contaminated by floodwaters. Hardening these facilities against future floods would reduce the damages and improve public health during flooding.

Who: Board of County Commissioners, Public Works, Planning Administrator
When: To commence during the first year and continue from then on.
Resources: None necessary, policy decision.

❶Offer a <u>voluntary</u> program for acquisition, relocation or flood proofing for floodplain residents or businesses that wish to relocate out of the floodplain or flood proof their homes and businesses with priority given to those properties with a history of repetitive losses.

❷Conduct inter and intradepartmental reviews of relocation/buyouts and prepare a report to provide the Shoshone County Board of County Commissioners adequate information for decisions.

Homes and businesses located in the floodplain are under constant threat of damage. While it is not possible for every home or business to relocate out of the floodplain, there are those with substantial or repetitive damages who may wish to relocate. The county, in conjunction with Kootenai County, has begun a program of buyouts for homes with repetitive losses in the Cataldo area and other locations due to the 1996 and 1997 flood events. This program should be reviewed and continued. It is the most effective way to reduce flood damages and restore the natural course of streams and rivers.

Who: Board of County Commissioners and county staff in conjunction with Idaho Bureau of Disaster Services and FEMA.
When: Continue from current projects into the short, medium and long-range.
Resources: IHMGP, Small Business Administration, none for policy decision on program review.

❶Amend the Shoshone County Floodplain Ordinance to require that floodway and floodplain boundaries be delineated on all survey maps and a base flood elevation be established in Zone A's.

This action would insure that when property is bought or sold that this information is available to the buyer and seller to inform them about the buildable boundaries of their property. This avoids future conflict with officials who must insure that that all structures and property development meets federal and state regulations.

Who: Board of County Commissioners.
When: Within the first year after adoption of the plan.
Resources: None needed, policy action.

Natural Resource Protection

❶Support public and private best management practices that promote stream bank stabilization efforts on rivers and tributary creeks and maintenance of vegetation or revegetation of slopes adjacent to floodplains.

Erosion is one of the primary causes of stream deposition during floods. Efforts to stabilize the stream banks with rip rap and revegetation could reduce the amount of deposition that occurs during flooding. Upland revegetation would also reduce the amount of silt and rock that travel to the edges of the stream banks. A cooperative approach to stream bank stabilization efforts is the only way to effectively address this action step. The county should adopt a set of best management practices for public projects, review land development regulations to assure they promote best management practices and support stream bank stabilization efforts of state and federal agencies. It is also important for the County to support programs that assist private citizens with stream bank stabilization projects.

Who: Board of County Commissioners, Public Works Department, Planning Commission.
When: Within one year of the adoption of the plan and continuous thereafter.
Resources: IHMGP, NRCS Small Watershed Protection and Wetland Preserve Program, U. S. Forest Service.

Emergency Services

❷Invite the elected leadership of Benewah County to develop, annually review and update as needed a protocol with Shoshone County that addresses joint flooding issues such as warning, access and emergency communications on the St. Joe River.

❷ Have the Shoshone County Emergency Services Coordinator work on joint emergency management flooding issues on the Coeur d'Alene and St. Joe Rivers with other county coordinators and the North Idaho Bureau of Disaster Services Area Field Office on an ongoing basis.

Problems of coordination between all the affected counties can occur. Therefore, cooperative meetings of the elected officials and emergency service directors in these counties would help to establish coordinated activities to ensure citizens and property along rivers and streams receive timely and adequate emergency services. For example, the major access route to the upper St. Joe River valley is through Benewah County. Although the river itself creates greater flooding problems in the Benewah County reach, access to the valley is critical during flooding. The flooding issues in the Cataldo area are another illustration of the need for ongoing inter-jurisdictional coordination.

Who: County commissioners of all counties, county emergency services and sheriff's staff, and Idaho Bureau of Disaster Services.

When: During the second year after adoption of the plan and every year thereafter.
Resources: County Commissioner's Budget, County Disaster Services Budget.

❶Preplan and check early warning systems to be sure that emergency service equipment is available on both sides of all rivers.

In the past there have been problems of availability of emergency service equipment and other flood fighting and emergency equipment because they were on the opposite side of the river during floods. This is particularly true on the North Fork of the Coeur d'Alene River where the north shore road provides the only access to a number of locations. Preplanning the location of equipment prior to the flood would help to eliminate this issue.

Who: County public works and emergency services staff.
When: Within the first year after adoption of the plan and ongoing thereafter.
Resources: Public works and emergency services budget.

❶Revise and update the Shoshone County Emergency Operations Plan.

❷Develop and maintain, in cooperation with citizens, neighbor-to-neighbor community based emergency plans to deal with local flood warnings and emergency supply needs as a supplement to the overall countywide emergency operations plan.

The County should continue the development of the Emergency Operations Plan which has been on hold. Funds should be released to allow for a substantial revision based upon lesson learned from most recent floods. An essential part of this plan update will be recognizing the key role volunteer citizens play in emergency response. Self-help and self-reliance are a fact in the more remote valleys of the county. Organizing and soliciting the help of citizens in flood fighting and emergency services and communication can extend the effectiveness of the county's operation.

Who: Director of Emergency Services, Sheriff, fire districts and other affected county departments, and community groups.
When: Within the first two years after adoption of the plan.
Resources: County Emergency Services Budget, volunteers and donations.

❶ Establish and maintain a Special Revenue Fund in the Shoshone County budget to be used exclusively for leveraging matching funds for disaster mitigation and response.

Eligibility for most grants from state and federal agencies requires some type of a match, in money or in-kind services, from the local government entity applying for assistance. Often, the existence of a contingency fund restricted to disaster mitigation and response may be a prerequisite to obtaining grant funding. The county can begin and maintain this fund with an annual contribution as small as $100. Over time interest will accrue with additional commitment of county resources and placement of all disaster grant monies in this fund.

Who: Board of County Commissioners
When: Adopt in the county budget within one year of the adoption of the plan.
Resources: County revenue, donations.

Structural

❷***Prioritize and complete improvements and or repairs to flood damaged county roads and bridges.***

Some roads and bridges impacted by recent floods are still in need of repair. Setting priorities on those that are most critical and then moving ahead with repairs would assist in maintaining access to areas of the county.

Who: County public works staff and Board of County Commissioners.
When: Plan during first year after adoption of plan and repairs to follow in the second to fifth years.
Resources: Federal Highway Administration Emergency Relief Funds, Idaho Department of Transportation, IHMGP, County Road Fund.

❷***Work with the Corps of Engineers to review the condition of all dikes, develop programs to repair damaged dikes, maintain existing dikes and suggest the creation of dike districts.***

❷***Identify tributary creeks in gulches along the South Fork of the Coeur d'Alene River that impact incorporated and unincorporated communities and meet with appropriate city and other local officials to discuss joint solutions, identify funding sources for maintenance and repair of existing control measures and develop new measures.***

There has been controversy over the responsibility for the repair and maintenance of dikes along the creeks and rivers in the county. This is particularly true along Pine Creek. It is necessary and beneficial that the community cooperate with the Corps of Engineers to establish appropriate responsibility for these activities. Dike districts, acting as a local taxing district, might be able to resolve this problem. Idaho Code provides for the formation and operation of Flood Control Districts (Idaho Code 42-3115). Cooperation between the county and the cities within the county on the repair, maintenance and building of new structural facilities can also be beneficial in reducing future flood damages.

Who: Board of County Commissioners, County Floodplain Administrator, County Emergency Services Director, County Public Works Department in cooperation with cities and flood control districts.
When: Within two to five years of the adoption of the plan.

Resources: Corps of Engineers, NRCS, Rural Economic and Community Development Services, IHMGP, Community Development Block Grant – planning only, property taxes.

❶***Support the scheduling of the repair of the erosion control measures along the South Fork of the Coeur d'Alene River to protect the Shoshone County Public Safety Facility from future flooding.***

This facility is located adjacent to the South Fork of the Coeur d'Alene River in Wallace. It is the primary location of emergency services coordination for the entire county. It is essential that all flood prevention facilities are maintained and improved to insure that this facility is available during emergencies.

Who: Board of County Commissioners and affected county staff.
When: Commencing within the year following the adoption of the plan and continuing thereafter.
Resources: Corps of Engineers, NRCS.

Public Information

❶***Identify and publicize alternative routes into and out of populated areas susceptible to road closures during flooding.***

❶***Be sure signs at detour roads are specific and easy to read and understand.***

Access to and from flooded areas is essential during flooding. Road closures due to flooding cause problems for emergency service personnel, schools and the public in general. Providing the public with useful information about alternate routes can reduce this problem. The County Public Works Department, Sheriff and Disasters Services can identify these routes. They can then be disseminated to the general public annually and made available to Fire and School District personnel. It can be expected that not all people will pay attention to this information until an emergency is imminent; however, timely placement of detour signs can aid in avoiding this situation.

Who: County Public Works, Sheriff and Emergency Services.
When: Should commence within the first year after the adoption of the plan and be continuous thereafter.
Resources: County Public Works Fund, Idaho Department of Transportation-District One, local newspapers and radio, Access Idaho Internet site, include in annual notice to residents.

❶***Conduct an annual workshop to listen to people's concerns, communicate floodplain rules and provide information on potable water, food, sandbags and first aid to assist citizens to prepare for floods in the Coeur d'Alene and St. Joe River Valleys.***

❶***Encourage individual responsibility and self-help during flooding events by providing an annual notice to residents in utility bills reminding them of flood hazards and the need for an adequate supply of food, potable water, a first aid kit and sandbags.***

The more remote areas of the county can be isolated for several days during a flood event. Self-help and self-reliance are bywords in these areas. Meeting annually with citizens makes them aware of the county's emergency procedures, helps to coordinate self-help activities with these procedures and clarifies county floodplain regulations. This is an opportunity for county staff to become aware of citizens' problems and issues in specific areas.

Publishing and dissemination of disaster readiness information to the general public is important, not only for general preparedness for flooding or other disasters, but also to assist people who may need emergency services. The County and other agencies and organizations providing utility services could share the costs for the printing and distribution of this information. This type of partnership approach will involve more people in flood preparedness planning as well as assist in cost sharing.

Who: Floodplain Administrator, County Emergency Services, Sheriff and local utilities.
When: Prior to the flood season during the first year after the adoption of the plan.
Resources: County emergency services budget, Avista, GTE, Shoshone County Water and Sewer Districts, U. S. Forest Service.

❶***Place signs at county lines which read: Building Codes and Floodplain Ordinances Enforced.***

With the amount of recreational and second home development along the streams in Shoshone County, visitors and newcomers are often not aware of floodplain restrictions. These signs would help to make people aware.

Who: Public Works Department
When: Within one year of the adoption of the plan and ongoing thereafter.
Resources: Public works budget, county general fund.

❶***Prepare a pamphlet <u>specifically</u> for Shoshone County residents and businesses that explains the Flood Insurance Rate Maps and the map legend in terms that people can easily understand and relate to their property.***

Citizens not only complained about the possible accuracy of the FIRM maps, but they also found it difficult to read and interpret them. A pamphlet explaining the terms, symbols and other information on these maps would help to reduce confusion. It is important that the pamphlet be specific to locations in Shoshone County.

Who: Floodplain Administrator

When: Within the first year after the adoption of the plan and continuing thereafter.
Resources: Public works budget.

❶ ***Make publications available at County offices and public libraries which teach people how to prepare for floods.***

❷***Make Shoshone County floodplain regulations and information on obtaining necessary permits for activities in the floodplain available on the Internet when the county develops a home page.***

Flood mitigation information and county procedures should be widely available to citizens of the county and anyone anticipating developing properties in the county. A large amount of free information is available to local entities from such agencies as FEMA and the Idaho Bureau of Disaster Services. By distributing information to public libraries and on the Internet, this information becomes widely available.

Who: County Floodplain Administrator
When: Within one year in the libraries, within two years on the Internet.
Resources: Public works budget and utilization of publications from FEMA, Corps of Engineers, Environmental Protection Agency, State of Idaho Department of Water Resources and Environmental Quality, Idaho Bureau of Disaster Services, Access Idaho web site.

TECHNICAL INFORMATION

Shoshone County Description, Topography and Climate

Shoshone County is located in the northern panhandle of Idaho. The county encompasses some 2640 square miles and is bounded on the east by the State of Montana (Rural Northwest 2000). Its northern boundary is Bonner County, Idaho which, along with Kootenai, Benewah and Latah Counties forms its western boundary. Clearwater County, Idaho lies to the south. Approximately 82% of the county is federal lands in the Coeur d'Alene, St. Joe and Clearwater National Forests. Thus, excluding the towns and cities within county, the amount of developable land controlled by the county is very small and for the most part is found in the low-lying areas along its principle rivers and streams.

The U. S. Census Bureau estimated the 1997 population of Shoshone County to be 13,982 (U. S. Census Bureau 2000). The population has stabilized after declining for several decades. The largest portion of this population lies along the I-90 corridor in the principal cities of Mullan, Osburn, Wallace, Kellogg, and Pinehurst. A considerable amount of the rest of the population resides in smaller unincorporated communities along the I-90 corridor and in the developable valleys of the North and South Forks of the Coeur d'Alene River and the St. Joe River basin. Since the majority of the population resides in the lower reaches of these river basins, many of them are subject to periodic flooding. Much of the development in these basins is second home and recreational development. Although there is potential for increased permanent development, much of the future development will more than likely be recreational.

The topography of Shoshone County is mountainous and scenic. The county contains portions of the Bitterroot, Coeur d'Alene, St. Joe and Clearwater Mountains some of which rise to nearly 7000 feet (U. S. Department of Housing and Urban Development 1979). The Coeur d'Alene and St. Joe Rivers are primary tributaries of the Coeur d'Alene Lake and the Spokane River Basin with the Coeur d'Alene to the north and the St. Joe to the south. A small portion of the St. Maries river passes through the southwest corner of the county near Clarkia, and parts of the Clearwater River lie within the national forest in the southern portion of the county. With the exception of the last few miles of the Coeur d'Alene River as it passes out of the county into Kootenai County, all of the valleys of the major rivers are relatively narrow and contain most of the development in the county.

With the exception of the low-lying bottomlands, the soils are shallow and perched on bedrock and are subject to erosion (Department of Housing and Urban Development 1979). This erosion, along with poorly drained soils and high water tables in the lower elevations, has increased bed loading in the adjacent streams and changed the nature of stream flow and flooding over the years. Anecdotal evidence suggests that the North Fork of the Coeur d'Alene has significantly changed over the past fifty years, particularly at its confluence with the South Fork.

Prevailing westerly flows of maritime air from the Northern Pacific Ocean influence Shoshone County's climate. Annual precipitation ranges from 30 to 38 inches in the lower valleys of the county but can climb to over 50 inches at higher altitudes (see Table 1). The total precipitation at the Lookout Mountain Snotel station from October 1, 1999 to July 1, 2000 was 50 inches and this is not at the highest elevation in the county nor a full year of data (Western Regional Climate Center 2000). Similarly, total annual snowfall varies from the lower valleys to the top of the mountains. Average annual snowfall on Lookout Mountain is more than twice the snowfall at Kellogg. These are averages. Extreme annual snowfall can rise to nearly 180 inches at the stations of record. It is the accumulation of snowfall over the winter months and the potential for warmer rainy days that pose the greatest flood threat through the winter and spring.

TABLE 1
ANNUAL CLIMATE SUMMARIES FOR SELECTED LOCATIONS IN SHOSHONE COUNTY

	Mullan	Wallace	Kellogg	Avery Ranger Station
Average Max. Temp. (F)	55.9	57.1	59.2	56.0
Average Min. Temp. (F)	33.6	34.1	34.8	35.1
Highest Average Monthly Temperature	78.6	83.7	85.2	83.7
Lowest Average Monthly Temperature	21.3	20.2	20.0	20.7
Average Total Precipitation (in.)	35.2	39.9	30.8	38.1
Average Total Snowfall (in.)	111.9	72.8	54.4	84.3

Source: Western Regional Climate Center
Note: Years of observations vary for each location.

Although the average annual maximum temperatures are in the middle to high fifties, the highest monthly averages range from 78.6° to 83.7°. The lowest average monthly temperatures are in the low 20's; however, extremes are possible. Summer temperatures can climb over 100° and, when cold arctic air breaks over the crest of the mountains, winter temperatures can drop to -20°.

Flood History

Nationally, floods are the most destructive and costly natural disasters. Shoshone County is no exception to this rule. Recorded floods have occurred in Shoshone County since the late 1800's. Given the steep terrain and the narrow valleys, these floods are characterized by the havoc they have created from inundation, destruction and severe erosion and sedimentation (Department of Housing and Urban Development 1979). Recorded floods have occurred in 1893, 1894, 1896, 1917, 1933, 1938, 1964, 1974, 1995, 1996 and 1997. Most recently, minor seasonal flooding happened in the spring of 2000.

Most flooding occurs from December to May. The highest floods are usually winter floods where heavy rainfall augments the normal snowmelt. These floods can rise to extreme flood depths within 2 days. Spring floods occur more frequently but are usually lower and longer lasting and are also characterized by rain on snow (Department of Housing and Urban Development 1979).

The term "100 year flood" refers to a water level in a stream or river that rises to a depth that would occur on the average interval of 100 years. However, the term is misleading. In reality, a "100 year flood" really means that this flood has 1 chance in 100 of occurring in any given year. More than one "100 year flood" can occur in any year and many can occur in any century.

1890

One diary of hardrock mining in the Coeur d'Alene district mentions flooding in Wallace in April of 1893.

> *April went out like a torrent. On the 30th, flood waters threatened the Sixth Street railroad bridge, and the citizens had to band together and collect funds, with which to pay for the raising of the bridge two feet at one end to allow the raging waters to pass. Their efforts took them four hours, but the bridge was saved. Some joker at Mullan telephoned a Wallace man and informed him that he ordered 500 life preservers for the people in Wallace. (Magnuson 1968, 91)*

1894

Heavy flooding occurred throughout the Pacific Northwest from late May through mid-June in 1894. Reports of 10 to 12 feet of snow in late may in the basins near Wallace suggests

that there was an above normal snowpack for the winter of '93-'94. With a cool early spring and temperatures warming to the 80's in May, rapid snow melt surged into the Coeur d'Alene and St. Joe Rivers (Spokane Review 1984a). Flooding was widespread cutting railroad traffic throughout the region. Reports suggested that the Coeur d'Alene River and its tributaries were higher than ever before (Spokane Review 1984b.) The Coeur d'Alene Lake rose to 2137.5 feet; however there is no estimate of the damages created by this flood (Hobson 1940).

1896

In the late spring of 1896 another serious flood occurred in the upper Coeur d'Alene River valley. The most serious flooding occurred near Wallace. The flood damaged railroads that had been repaired in the previous year following the 1894 flood. The Coeur d'Alene Lake peaked at 2131.5 feet on June 7.

1917

Record warm temperatures occurred in late December 1917, and early January 1918. The high temperature in nearby Spokane, Washington on January 1, 1918 was 62°. Buds were reported to have appeared on fruit trees and lilac and rose bushes in Kellogg on January 2. Over 7 inches of rain fell in the St. Joe River valley from December 1 – 20 and continued to fall in the Coeur d'Alene and St. Joe watersheds through the end of the month. This culminated in a flood on Christmas Eve. The Coeur d'Alene Lake reached 2137.5 feet and the Cataldo electric substation was inundated. The flood caused serious damage, but the amount of this damage was never recorded (Hobson 1940). The following are excerpts about the flood in the December 24, 1975 *Kellogg Evening News* discussing the 1917 flood.

> *At Wallace the ravages of Placer Creek will mount into the thousands of dollars and entailed losses that cannot be estimated in dollars and cents.*
>
> *Homes were wrecked along the stream, houses were carried down bodily with their contents, and some of the most beautiful homes in the city were undermined, lawns washed away, and losses entailed which place a heavy burden on the owners.*
>
> *In short, the home section of the city was swept by the rushing uncontrolled waters, leaving a scene of wreck and desolation that is most distressing to view.*

1933

Again in 1933, heavy rainfall on snow and warming Chinook winds caused another December flood. 19 inches of rain fell in the Wallace area between the 1st and the 6th creating torrential streams that rushed through Wallace. Water depth in the canyon above Wallace was 10 to 12 feet. Roaring streams crashed down the gulches surrounding Mullan, Wallace and Kellogg. Water entered the second story windows of many homes in the county (Department of Housing and Urban Development 1979). People were rescued from their rooftops by boat in the Cataldo area. A large logjam near the confluence of the north and south forks of the

Coeur d'Alene River broke loose and carried away hundreds of feet of railway track and the steel highway bridge at Cataldo was damaged by flood-borne debris. Similar flooding occurred along the St. Joe River. Reports indicated that a Milwaukee Road train was derailed by a landslide caused by the flooding near the Town of Avery.

The estimated peak discharge for the Coeur d'Alene River at Cataldo was 67,000 cubic feet per second (cfs) placing it near an 80-year flood level. At Calder, the St. Joe River peaked at 53,000 cfs, slightly less than a 100-year flood level (Department of Housing and Urban Development 1979). The result was an all-time record elevation of 2139.5 feet for Coeur d'Alene Lake exceeding the summer level of 2128 by 11 feet. At the height of the flooding, pilots reported that Coeur d'Alene Lake as "a great inland sea stretching from Coeur d'Alene to St. Maries to Wallace (Spokesman Review 1933)".

Up to this time, this was the most serious flood. Property damages were estimated to be $3,500,000 for Shoshone County alone (Hobson 1940).

1938

Again in spring of 1938, warm Chinook winds produced a rapidly melting snowpack that flooded the Silver Valley in April. Flooding began on the South Fork of the Coeur d'Alene River and spread downstream. This flooding was very similar to flooding that was to occur in 1974 (Department of Housing and Urban Development 1979). U. S. Highway 10 was covered at Cataldo. Heavy flows also occurred on the St. Joe River. Coeur d'Alene Lake crested at 2134.5 feet on April 22, five feet below the 1933 flood.
There was an estimated $100,000 of total damage to Mullan, Wallace and Kellogg (Hobson 1940).

1964

Two floods occurred in 1964. In June, high elevation runoff from the previous winter created flooding at lower elevations. However, the more severe flooding occurred in December. December was particularly snowy with large accumulations of snow and temperatures dipping into the –20's. On December 22 and 23, temperatures rose to the upper 40's. This rise in temperature coupled with heavy rainfall triggered flooding in the major streams of the county. A foot of water covered U. S. Highway 10 at Cataldo. The water system at Calder was damaged, and the cities of Wallace and Pinehurst experienced damage. At Pinehurst, a levee system broke inundating the whole town but damage was minimal since the overbank water was shallow. Peak flow was estimated at 2150 cfs (Department of Housing and Urban Development 1979). The flooding subsided as temperatures dropped on Christmas Day.

1974

January 1974 marked one of the most severe flood events in Shoshone County. A warm weather storm brought temperatures in the 50's and as much as 9 inches of rain over a 4-day period along the upper reaches of the Coeur d'Alene River. This rain fell on snow perched over frozen ground which was unable to absorb the runoff from the melting snow producing

record flows on both major rivers. The USGS computed peak discharge of the Coeur d'Alene River at Cataldo to be 79,000 cfs on January 16. This is slightly above the estimated 100-year flood. The river crested at 7 feet above flood stage (FEMA 1984 and Department of Housing and Urban Development 1979). However, the South Fork discharges varied during the flood event. For example, the peak discharge at Smelterville was 11,500 cfs, slightly less than a 50-year event. Thus, running accumulations down the river intensified the flooding. The peak flow at Calder on the St. Joe River was 33,000 cfs, slightly less than 50-year flood.

The flood produced widespread damage. Towns along the rivers and tributaries were inundated. State, county and local roads were damaged or washed out. Traffic along Interstate 90 was delayed by floodwaters covering the highway. Bridges, culverts and recreational sites received the most damage. Much of this latter damage was cause by floating debris traveling downstream. People were stranded in Murray and Prichard and along the North Fork of the Coeur d'Alene River. Avery and Calder were isolated along the St. Joe River for 3 to 4 days. People were evacuated from their homes in Cataldo and Kingston. Major utility services were interrupted.

1995

In 1995, Shoshone County suffered through two flood events. In late February, with rising temperatures melting snow, flooding occurred on both the Coeur d'Alene and St. Joe Rivers. Roads were washed out and homes were flooded. The St. Joe peaked at 33.5 feet after rising nearly 8 feet in 24 hours (Welch 1995a). The Coeur d'Alene at Cataldo rose more than 11 feet in 48 hours. Pine Creek destroyed 325 feet of levee near Pinehurst (Roesler 1995b).

In early December warm winds and rain produced another flood event in the county. The St. Joe River crested 11 feet above flood level, and the Coeur d'Alene River at Enaville crested at 47.3 feet, four feet above flood level. Recreational vehicles were washed downstream and public wells were contaminated with floodwater (Welch 1995b,c.) Another near flood occurred in mid-December as warm temperatures, rain and winds melted mountaintop snow. However, flood stages were missed by several feet (Roesler 1995b).

1996

Following on the heels of the December 1995 flooding, rivers and streams rose again in February of 1996 as a result of warming temperatures and rain. Four days of heavy rain and mild temperatures produced an estimated $100 million in damage in North Idaho. Damage in the Coeur d'Alene River valley was estimated at $24 million (Federal Emergency Management Agency 1996).

Ice and ice jams were a threat. Two hundred Cataldo residents were asked to evacuate as a result of an ice jam breaking in the North Fork of the Coeur d'Alene River (Roesler and Benedetti 1996). Although early predictions suggested flood stages would not be reached, continued warm weather and rains pushed streams above flood stage. On February 8, Mullan had 1.5 inches of rain in several hours (Prager 1996). The Coeur d'Alene River at Cataldo

reached flood stage of 43 feet on the 7th and rose 4 feet above this mark on the 8th and peaked at 53 feet on the 9th. The USGS estimated the Coeur d'Alene River peak flow as 70,000 cfs. Table 2 indicates the peak flows during the flood at the major gauging stations in the county. All were slightly less than the 100-year flood peaks.

The towns of Enaville and Pinehurst were inundated. One thousand people were isolated in Pinehurst and Cataldo when the Pine Creek Dike ruptured. People were stranded in Murray and Prichard, and along the St. Joe River it took several days before those stranded found alternative routes out of the valley. Others had to be plucked from their homes by helicopter (Titone 1996a). A large mudslide closed the St. Joe River 13 miles east of Avery with the closure continuing into the fall as environmentalists objected to the use of fill in the river to shore up the road. As is always possible with flooding in the Silver Valley, toxic mine wastes were swept downstream. One USGS scientist estimated lead and zinc moved into Lake Coeur d'Alene daily during the flood (Titone 1996b).

Periods of flooding continued throughout the spring of 1996. The 1996 flood devastated much of North Idaho as well is the rest of the Pacific Northwest. More than 1650 families registered for disaster housing assistance in North Idaho (Butler 1996). The Corps of Engineers estimated repairs to the state and county owned levees would be $16 million (Firehammer 1996).

TABLE 2
1996 PEAK FLOOD FLOWS

Gauging Station	1996 Peak Flood Flow (cfs)	100-Year Flood Flow (cfs)	Date and Magnitude of Historical Flood Peak (cfs)
North Fork, Coeur d'Alene River at Enaville	56,600	58,400	Jan. 16, 1974 61,000
South Fork, Coeur d'Alene River near Pinehurst	11,700	No previous reference data	No previous reference data
Coeur d'Alene River at Cataldo	68,300	70,800	Dec. 23, 1933 79,000
St. Joe River at Calder	38,700	43,000	Jan. 5, 1974 53,000
St. Maries River at Santa	12,300	14,100	Jan. 5, 1974 10,100

Source: USGS 1996

1997

The winter of 1996-97 produced the most snow since 1972. By March, some drainage basins in Northern Idaho had nearly twice the normal snowpack (see Table 3 below). During the spring, most areas of Northern Idaho received above normal precipitation making flooding a common occurrence from March through June.

TABLE 3
SNOWPACK SUMMARY - MARCH 1997

Drainage Basin	Percent of Average Snowpack
Coeur d'Alene River	155%
St. Joe River	159%
Spokane River	158%

Source: Natural Resources Conservation Service

Minor flooding occurred during March. By mid-April the Coeur d'Alene and St. Joe Rivers began climbing towards flood stage and crested above flood stage by early May. Low lying areas adjacent to both rivers were affected and by May 16th, Coeur d'Alene Lake rose above flood stage to 2133 feet as flood waters from these rivers spilled into the lake. Old River Road along the North Fork of the Coeur d'Alene River was impassable, and the St. Joe River Road to Calder was closed causing residents to take a 20-mile detour to reach St. Maries. Mill Creek surged into Mullan filling basements (Drumheller 1997). Water boiling orders were common throughout the county as floodwaters contaminated both private and public wells.

Perhaps the most devastating result of the 1997 flood was the breaching of the infrastructure that carried Milo Creek out of the canyons through Wardner and Kellogg to the South Fork of the Coeur d'Alene River. This above and below ground waterway constructed over the years was destroyed by the flooding sending water coursing down through the cities of Wardner and Kellogg, and the Bunker Hill Superfund site. More than 50 homes and approximately 5 miles of public right-of-way were damaged as sinkholes appeared. Sediments containing lead were deposited along the flood areas (Terragraphics Environmental Engineering 1997).

Floodprone Areas

As noted before, the disposition of developable land within Shoshone County lies primarily in the valleys of its major river valleys and their tributaries. For the most part these valleys are relatively narrow. Floods in these canyons, gulches and valleys tend to be vigorous and destructive given the steepness of the surrounding mountains and the rain on snow events that characterize the most serious floods. These flood events can be characterized as major events or seasonal in nature. Major events tend to be flashy, rapid and of short duration. Seasonal events last longer, but are not as flashy and can still create a fair amount of destruction. Regardless, they have the potential to create damage throughout the county.

The following description of floodprone areas is organized around the two major river basins, the Coeur d'Alene and the St. Joe. Flooding occurs on the St. Maries, but the largest damages along this river over the last decade have been downstream near the City of St. Maries in Benewah County. The information below is organized by river watershed. The data on stream flows and flood elevations are abstracted from the U. S. Department of Housing and Urban Development (1979) flood insurance study for Shoshone County and several USGS web sites (USGS 2000 a & b). The flood insurance study is dated, 1979, and is keyed to the county's Flood Insurance Rate Maps (FIRM). The floodprone areas map in Appendix E are derived from these maps. For accurate elevations at any specific location, one should refer to the FIRM maps. These maps need updating to reflect flooding that has occurred since they were developed. Thus, data presented below are approximate but current estimates of the flood potential in these areas of the county.

North Fork, Coeur d'Alene River

TABLE 4
FLOOD FLOWS
NORTH FORK, COEUR D'ALENE RIVER

Gauge Location	Flood Stage in Feet	10-Year Flood Discharge (cfs)	50-year Flood Discharge (cfs)	100-year Flood Discharge (cfs)	Highest Discharge (cfs)
Prichard	NA	11,600	17,100	19,600	22,000
Enaville	72	31,000	49,300	58,400	61,000

NA = Not Available
Source: USGS 2000 a & b

The North Fork of the Coeur d'Alene River begins in the upper reaches of the northern and eastern edges of the county near the crest of the mountains and the Montana border. The river flows westward and south until joining with the South Fork near Kingston. The river and its tributaries flow through narrow valleys with much force during flooding. Some residents claim to hear rocks bounding down the river during floods. Although the 1996 flood perceptually was dramatic, the highest recorded stream flow was in 1974 where the flow exceeded the estimated 100-year flow by more than 2000 cubic feet per second (see Table 4 above).

Flood protection measures are minimal along this portion of the river. Some dikes have been built and residents have hardened the banks of the river with rip-rap, but for most reaches of the river, it runs its normal course.

The towns of Murray and Prichard are located a tributary of the North Fork of the Coeur d'Alene River. These small communities became inundated during flood events. In addition, over the past decades, low lying land along the river has become attractive for second home and recreational vehicle park development. As a result, there is potential not only for normal flood damage but also damage created by floating debris and hazardous materials such as propane bottles, and portable outhouses that become dislodged from RV sites and float downstream. Sewage and solid waste are also transported downstream during floods.

Access to many of these locations occurs along the Old River Road on the north side of the river. However, floods close this road and reduce access to permanent and temporary homes along the riverbank. Ice and ice jams in the river and its tributaries can cause surges of floodwater. Trees along the banks of the river get washed out and fall into the river during floods and cause damage to bridges and other structures along the river. Flooding also occurs along the tributaries, particularly Beaver Creek.

Deposition of soil and rock in the streams and rivers during flooding is normal. Rock and soil is washed downstream from higher elevations. Past logging practices often contributed to increased stream deposition. As the stream fills with deposits, the course of the stream shifts. Residents, various agencies and logging firms have used rock rip-rap to shore the

sides of the streams; however, while this might be helpful in saving the shoreline for that individual or agency, it can create headaches for others either across or downstream as the river changes course.

South Fork, Coeur d'Alene River

The South Fork of the Coeur d'Alene River begins in the mountains near Lookout Pass and flows westerly down steep terrain through Mullan, Wallace, Kellogg and other cities before joining with the North Fork. There are levee systems along some of the tributaries (i.e., Pine Creek) and on the river and in some locations underground culverts or concrete channels are used to carry storm water (i.e., Wallace and the Milo Creek infrastructure). Most of the levee systems are not sized to carry a 100-year flood.

TABLE 5
FLOOD FLOWS
SOUTH FORK, COEUR D'ALENE RIVER

Gauge Location	Flood Stage in Feet	10-Year Flood Discharge (cfs)	50-year Flood Discharge (cfs)	100-year Flood Discharge (cfs)	Highest Discharge (cfs)
Kellogg	16.3	4,500	7,830	9,560	11,100
Pinehurst	NA	NA	NA	NA	11,700

NA = Not Available
Source: USGS 2000 a & b

The South Fork of the Coeur d'Alene River valley contains over 60% of the county's population, mostly in the cities along the I-90 corridor and adjacent to the river. Much of that population is subject to flooding. In addition there are a large number of tributaries that also flood causing damage during severe floods. For example, Jackass creek flows adjacent to Kellogg High School. When the stream breaks over its banks, it flows through the High School, which is located in the county and not the city.

Heavy deposition also occurs in the tributaries and the river. Coupled with the building of I-90 and years of piling mine tailings along the river have changed the course of the river. These tailings represent one of the largest Superfund sites in the country and remedial work has also changed the nature of flooding in the valley. All of these factors suggest that the FIRM maps need updating.

Past mining practices have left lead and zinc contamination throughout the Silver Valley. Each flood has the potential to churn up the contaminated soils and carry heavy metals downstream. Flood mitigation efforts need to be coordinated with the Superfund clean up throughout the valley.

Water contamination is a continuing problem during floods. Public and private wells become inundated instituting boil orders. Also some wastewater facilities are threatened by flooding. These are critical public facilities and need to be protected during floods.

Although all of the tributaries contribute to the flooding in the valley, two streams have caused serious damage over the last several floods. Milo Creek broke out of its underground infrastructure during the 1997 flood and caused damage in Wardner and Kellogg. Subsequently, a new structure costing nearly $17 million dollars is being constructed to absorb storm runoff. Pine Creek as it flows out of the county and into Pinehurst has breached the levees adjacent to the creek and damaged bridges that provide access to the upper reaches of the creek. In addition, it has flooded the golf course in Pinehurst. Some dikes have been replaced, but all need major maintenance to insure that vegetation along the dikes doesn't create an additional hazard.

Cataldo Area, Coeur d'Alene River

TABLE 6
FLOOD FLOWS
COEUR D'ALENE RIVER AT CATALDO

Gauge Location	Flood Stage in Feet	10-Year Flood Discharge (cfs)	50-year Flood Discharge (cfs)	100-year Flood Discharge (cfs)	Highest Discharge (cfs)
Cataldo	43.0	37,600	58,900	70,800	79,000

NA = Not Available
Source: USGS 2000 a & b

Cataldo straddles the county line lying both in Shoshone and Kootenai Counties. Just above Cataldo the two forks of the Coeur d'Alene River join and the terrain as well as the floodplain begins to flatten out and widen. The river slows down and expands outward. The last several floods have flooded homes and created more deposition. I-90 offers some protection to some properties but causes flood problems for others and even becomes inundated at times. These incidences occurred after the previous flood study suggesting the need for review of the FIRM maps. The counties, the state and FEMA have cooperated in either buyouts or the raising of homes in this area. Given the significant changes in river geography at this location and the potential for continued significant flood damage, this program needs to continue.

St. Joe River

TABLE 7
FLOOD FLOWS
ST. JOE RIVER AT CALDER

Gauge Location	Flood Stage in Feet	10-Year Flood Discharge (cfs)	50-year Flood Discharge (cfs)	100-year Flood Discharge (cfs)	Highest Discharge (cfs)
Calder	13.0	27,000	38,500	45,700	53,000

NA = Not Available
Source: USGS 2000 a & b

The St. Joe River valley is similar to the North Fork of the Coeur d'Alene River Valley. The St. Joe River begins in the mountains east of Avery and Calder and flows westward to St. Maries in Benewah County and into Coeur d'Alene Lake. The upper reaches of the river are designated as a wild and scenic river. Fewer people live in this valley which attracts fishermen and other sportsmen. Much of the economy of the river valley is based upon recreation. Flooding inundates the river road shutting off access to residences and businesses along the valley, particularly for the recreational users of the river. During the 1997 flood, a rock and landslide that severely limited the use of the road and affected tourist traffic covered the road east of Avery. Limited access also makes it difficult to get flood fighting equipment to key places.

Isolation also happens when power is lost during a flood. Given the location and topography of the valley, it is extremely difficult or impossible to send and receive information by cell phone or amateur radio.

During the last several floods, debris from fishing camps and RV sites floated downstream causing damage. Mobile homes at the Big Eddy were flooded as well as at Marble Creek. Trees fell into the river. Plugged culverts caused flooding in areas that were intended to drain. Logs used to create fish habitat increased flooding in certain areas and floated downstream.

Ice and ice jams also create buildup of water that then surges as the ice breaks loose sending water roaring downstream. This occurs at Spring and Marble Creeks as well as other locations along the river.

St. Maries River at Clarkia

TABLE 8
FLOOD FLOWS
ST. MARIES RIVER AT SANTA

Gauge Location	Flood Stage in Feet	10-Year Flood Discharge (cfs)	50-year Flood Discharge (cfs)	100-year Flood Discharge (cfs)	Highest Discharge (cfs)
Santa	NA	6,900	11,700	14,200	12,300

NA = Not Available

Source: USGS 2000 a & b

Clarkia lies on the St. Maries River in the extreme southwest corner of the county. Although the residents of Clarkia are citizens of the county, their access is upriver from the City of St. Maries, which is in Benewah County. In this area, the roads were damaged and access was limited.

Summary

Information about floodprone areas suggests that there are several issues or problems that need resolution. First, severe deposition during floods will continue. if As logging practices change in the forests above these streams, some of the deposition may decline. However, remedial actions to either remove deposition when possible or creating areas of containment would be beneficial. Second, streambank maintenance and stabilization can help reduce breached levees and reduce the natural debris that enters the rivers during flooding. Third, floodplain development needs to be controlled to minimize hazardous debris and to insure no substantial development in floodways and minimal development in floodplains. Fourth, any flood mitigation action needs to consider controlling the potential for heavy metals contamination. Fifth, all emergency service procedures, both public and private, need to be coordinated and disseminated to the public. Finally, all of the FIRM maps need updating to insure that certificates of elevation are correct and that remedial actions occur where necessary.

Floodplain Management

Floodplain management seeks to minimize the impact of flooding while recognizing that floodplains and other floodprone areas must be treated as integrated systems for both human activities and natural functions. Shoshone County has adopted a management program to work toward mitigation of the costs associated with flooding to floodplain occupants, communities, government entities and the natural environment. Components of the program are: participation in the National Flood Insurance Program (NFIP) to provide for reasonably priced flood insurance for private properties, adoption and implementation of a county flood damage prevention ordinance, and regulations addressing land development in floodplains.

National Flood Insurance Program

The NFIP is administered by the Federal Emergency Management Agency (FEMA). As a condition for making flood insurance available for private properties, local governments agree to regulate development practices in the floodplain. NFIP floodplain management has the following four minimum requirements.

- All development in the base floodplain must have a permit from the county. "Development" is defined as any man-made change to the land, including new buildings, improvements to buildings, filling, grading, mining, and dredging.

- Development should not be permitted in the floodway. The floodway is the channel and central portion of the floodplain that is needed to convey the base flood. It is

usually the most hazardous area of a riverine floodplain and is the most sensitive to development. At a minimum, no development in the floodway causing an obstruction to flood flows can be allowed. Generally, a hydraulic/hydrologic study is needed to determine if this will happen.

- New buildings may be built in the floodplain, but they must be protected from damage by the base flood. The lowest floors of residential buildings must be elevated to or above the base flood elevation. Nonresidential building must be elevated or floodproofed. No basements are allowed.

- When an addition, improvement or repair of damage to an existing building is equal to or exceeds 50 percent of the market value of the original building, then it is considered to be a substantial improvement. A substantial improvement is treated as a new building and must, therefore, comply with regulations for new development.

There were 105 NFIP flood insurance policies in Shoshone County in February 2000 with a total amount of $6,983,200 of insurance coverage. The average NFIP policy in the county is $66,507 and the average premium $345. There have been 86 flood insurance claims paid to private property owners in Shoshone County since 1987. The present insurance rate classification is 9. This provides a 5 percent discount on flood insurance premiums. It is expected that the county rating will be reduced to 8 within the near future which will increase the discount on insurance premiums to 10 percent.

Shoshone County also participates in the NFIP's Community Rating System Program (CRS). The program is coordinated by the State of Idaho Department of Water Resources. The program recognizes local government efforts beyond the minimum standards by reducing flood insurance premiums for private property owners. The system is based on credits for undertaking public information and floodplain mitigation activities. This program is managed by the Shoshone County Floodplain Administrator.

Shoshone County Floodplain Regulations

The Shoshone County Board of County Commissioners adopted Ordinance Number 49 on March 25, 1987 to help prevent flood damage. This ordinance is currently being amended to assure that Shoshone County meets all the requirements for the NFIP. New residential construction or substantial improvements must be elevated to at least one foot above the base flood elevation. Nonresidential construction has the option to flood proof the lowest floor. Encroachments into the floodway are prohibited unless it can be certified that the development will not increase the level of the base flood. A development permit is required for all development activities in the floodplain.

The Shoshone County Flood Damage Prevention Ordinance has additional provisions regarding implementation of the ordinance. These provisions provide for permit administration, use and interpretation of flood data, and variance and appeal procedures. The ordinance also contains a provision that subdivision proposals be consistent with the need to minimize flood damage.

In addition, the County Zoning Ordinance includes a Floodplain Overlay Zoning District in Article 7, Chapter 16 to guide land development in floodplains. This assures new zoning proposals in floodplains will receive review and, if necessary, conditions of approval. The County Planning Commission is also responsible for administrative appeals of permit decisions by the Shoshone County Floodplain Administrator.

Floodplain Development Trends

The primary land development in floodplains in unincorporated Shoshone County is residential. Trends indicate that building sites in floodplains in the County are becoming increasingly attractive for both residential and recreational development. There has been little commercial and no industrial development in floodplains in the last 20 years. Recent floodplain development trends were assessed using data from Elevation Certificates which are required as part of the building permit process for construction within flood zones in the county.

In the past 10 years, 80 percent of floodplain related development has occurred in the Coeur d'Alene River Watershed. The most popular area for land development is along the North Fork of the Coeur d'Alene River. The Pine Creek area north of Pinehurst represents another 16 percent of floodplain related development in the watershed. Land development along the St. Joe River from the county line east to Avery has been mainly recreational. The St. Joe River above Avery is in the National Wild and Scenic Rivers program and is not open to private development. There has been minimal development along the St. Maries River in Shoshone County.

TABLE 9
DEVELOPMENT IN FLOOD ZONE AREAS IN SHOSHONE COUNTY
1990 – 2000

Flood Prone Area	**Elevation Certificates**	
	Total	**% of Total**
Coeur d'Alene River	12	15
North Ford Coeur d'Alene River	30	37
South Ford Coeur d'Alene River	10	12.5
Pine Creek	13	16
St. Joe River	15	18.5
St. Maries River	2	1
Total	82	100

Source: Elevation Certificate Records, Shoshone County Public Works Department, June 2000.

Comprehensive information on Shoshone County floodplain development is limited at the present time. The most reliable available floodplain development data are Shoshone County Flood Elevations Certificates required as part of the permit process for construction or substantial improvements within the floodplain. There is no timely land use data available on the location of structures in the floodplain. In addition, there is serious debate as to whether NFIP Flood Insurance Rate Maps accurately depict flood zones as they currently exist. A number of proposed action steps in this flood mitigation plan recommend measures to provide this information as resources become available for appropriate land use studies.

DAMAGE ASSESSMENTS

Shoshone County has experienced significant damage due to flooding since the 1890's. In 1893 it was reported that "The White Bender Warehouse was washed away, as were the gardens at the Providence Hospital. Damages to the railroads in Canyon Creek amounted to between $10,000 and $30,000." (Magnuson, 1968). Property damage in Shoshone County from the 1933 flood was estimated to be $3,500,000 (Hobson, 1941). Estimates for damage created by the 1996 - 1997 floods in North Idaho exceeded $140 million not including lost business and wages. Public damage to local government entities from these floods in Shoshone County alone was over $7,000,000.

1996 - 1997 Floods

The two major flood events in the past 5 years, the flooding in February of 1996 and high water from April into June in 1997, caused a substantial amount of damage to local government facilities and services in Shoshone County. The damage assessments above and below for this flooding were organized from FEMA Damage Survey Reports (DSR's) submitted for funding under Presidential Disaster Declarations Number 1102, 1154 and 1177 and Federal Highway Administration Emergency Relief Projects Field Reports.

Almost all the of damage from the 1996 - 1997 flooding in unincorporated Shoshone County was to county roads, bridges and culverts. Emergency operations, debris removal and structural repairs accounted for the remainder of the reported damages.

TABLE 10
DAMAGE ASSESSMENTS
ALL ENTITIES IN SHOSHONE COUNTY
1996 – 1997

Entity		**Amounts**	**(In Dollars)**	**Total**
		1996	**1997**	
Shoshone County		$1,852,034	$148,631	$4,793,995
Cities:	Kellogg	16,248	1,460,174	1,476,422
	Mullan	16,795	305,767	322,562
	Osburn	14,166	9,874	24,040
	Pinehurst	4,824	31,213	36,037
	Wallace	35,285	37,768	73,053
	Wardner	0	94,470	94,470
School Districts:	#391 – Joint School (Kellogg)	5,115	0	5,115
	#392 – Mullan	0	1,606	1,606
	#393 – Wallace	0	3,666	3,666
	#394 – Avery	14,301	0	14,301
Public Utilities:	Cataldo Water	5,723	0	5,723
	Central Shoshone Water	48,531	11,920	60,451
	East Shoshone Water	0	4,580	5,480
	Kingston Water	1,261	0	1,261
	Kingston-Cataldo Water/Sewer	9,011	0	9,011
	Pinehurst Water	8,270	0	8,270
	Clarkia Highway District	0	6,588	6,588
	Captain John Mullan Museum	0	1,800	1,800
	Fire Protection District #2	2,754	5,893	8,647
Total:				$6,952,498

Source: Idaho Bureau of Disaster Services, June 2000.
Idaho Transportation Department – District 1, May, 2000.
Note: Dollar amounts include snow-related damage in 1997

TABLE 11
DAMAGE ASSESSMENTS FOR SHOSHONE COUNTY
GOVERNMENT BY TYPE
1996-1997 FLOODS.

TYPE OF DAMAGE	**AMOUNT (in dollars)**

County Road System	4,654,015
Debris Removal	8,842
Emergency Operations	34,800
Structural, non-road	51,702
Total	4,749,359

Source: DSR's for Disaster #1102, 1154,1177, Idaho Bureau of Disaster Services, FHWA Field Reports,
Idaho Transportation Department District - One, 2000.

Private Damage

The majority of private damage due to the 1996 and 1997 floods in unincorporated Shoshone County was to residential structures in floodprone areas along the North Fork of the Coeur d'Alene River and in the communities of Enaville, Cataldo and Barkerville. The County has offered a totally voluntary program to help individual homeowners in these flood hazard areas who have experienced serious or repetitive flood damage. This program involves purchase of flood damaged homes giving homeowners an opportunity to relocate outside of flood hazard areas. It also reduces the public costs of flooding in the future by acquiring private properties subject to frequent to flooding. Funding for the program is from the Idaho Flood Mitigation Grant Program.

TABLE 12
SHOSHONE COUNTY RELOCATION ACQUISITION PROGRAM
1996 - 1997 FLOODS.

Project Site	**Description**	**Total (in Dollars)**
Riverview	Acquire and removal, 9 homes	$282,650
Enaville	Acquire and removal, 5 homes	$438,620
Bumble Bee	Acquire and removal, 4 homes	$181,426
Coeur d'Alene River	Acquire and removal, 1 homes	$68,211
Palo Road	Acquire and removal, 1 homes	$97,896
Erickson	Acquire and removal, 1 homes	$44,000
Total		$1,112,803

Source: Idaho Bureau of Disaster Services, 2000

There was flooding of manufactured homes but no direct structural damages to businesses in the St. Joe River valley. The economic impact of the flooding on businesses in the St. Joe River valley and the communities of Avery and Calder is still being felt. Tourism, fishing and hunting are critical to the economic well being of the area and road access east of Avery along the St. Joe River Road, which is a key to the success of local businesses, is still an unresolved problem. The need to complete road repairs due to these floods is still a major con-

cern. Businesses along the North Fork of the Coeur d'Alene River also suffered loss of income during flood periods due to access issues.

HAZARD INVENTORY

A hazard inventory; a listing of the number of structures, type and use of structures, and approximate value has not been done for Shoshone County to date due to lack sufficient information and resources. This plan recognizes the need for Shoshone County to set up and maintain an adequate database to assist with flood mitigation activities. Action steps in the plan related to revision of the NFIP Flood Insurance Maps and a current land use survey data base will provide the information necessary to develop a useful hazard inventory. Once the hazard inventory is completed it should be added to this section of the Flood Mitigation Plan.

CRITICAL FACILITIES

Protecting critical facilities during a flood is an essential part of emergency services. If a critical facility is flooded, personnel and resources will be diverted from protecting lives and private property. There are two categories of critical facilities: buildings or locations vital to the flood response effort and buildings or locations that, if flooded, would create secondary disasters. In Shoshone County; critical facilities may be under the jurisdiction of private, federal, state, county or district authority.

TABLE 13
CRITICAL FACILITIES IN FLOODPRONE AREAS
IN UNINCORPORATED SHOSHONE COUNTY

A. Buildings or Locations Vital to Flood Response Effort Police and Emergency Operations Centers:
Shoshone County Public Safety Building*

Selected roads and bridges:

Roads	**Bridges**
I-90	Canyon Creek @ Gem Hill
Old River Road	West Fork Pine Creek:
Coeur d'Alene River Road	Ross Gulch, Milesi,
St. Joe River Road	Barkerville
Pine Creek Road	Pine Creek:
	Below Pine Creek Tavern
	Below Dose, Amy Matchless,
	Piekarski
	Falls Creek
	Zanes Bridge
	East Fork Eagle Creek

B. Building or Locations, if flooded would create Secondary Disasters

Hazardous Materials:
Kingston Texaco
Silver Valley Truck Stop
Babins Grocery
Yellowstone Pipeline

Transmission Lines:
Avista
General Telephone

Schools
Kellogg High School

Public Water/Sewer Facilities:
Avery Water/Sewer District
Clarkia Water & Sewer
Cataldo Water District
Central Shoshone Water District
East Shoshone County Water District
Kingston Water District
Kingston-Cataldo Sewer District
Page Water & Sewer District

Note: This table excludes facilities in incorporated cities with the exception of the County Public Safety Building which is in Wallace.

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Appendix I
Local Planning Processes

Overview

The hazard mitigation planning process is a six-step process. Although the first run through is linear, the process should be seen as an ongoing, iterative process.

The six steps are presented in flow chart format in Figure 1, and are explored in detail in the following sections

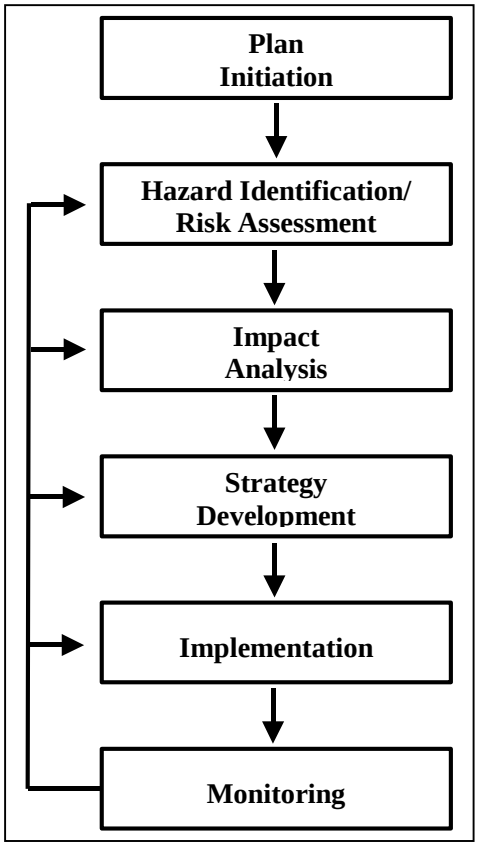

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Figure 6 - Planning Process

The most critical element of any successful plan is "buy-in" from agencies and individuals who will be responsible for funding and carrying out the recommendations of the plan. Community support is also essential and is dependent upon early and frequent involvement in the process and adequate public information.

Plan Initiation

The planning process is initiated by assembling the planning team and/or stakeholder group, establishing underlying goals and parameters for the process, establishing a preliminary timeline, and securing funding and resources (meeting facilities, staff support, communication infrastructure) for the process.

The planning process may be led by the local jurisdiction's staff or a community committee. Although it is a government document, the mitigation plan must reflect a strong element of public input in the development of strategies and identification of appropriate project types. When the effort is led by staff, a community committee comprised of major stakeholders (agencies and individuals who have a significant interest in the process and its outcome) is an essential support element. In some jurisdictions, it may be useful to have the mitigation planning committee as a subcommittee of the Local Emergency Planning Committee (LEPC). Composition of the group should reflect a balance between broad representation of the community and supporting players and manageable size. It should contain members representing:

- Emergency management
- Planning and zoning
- Building services
- Public works
- A response agency (law enforcement, fire, medical)
- Business
- Banking, insurance
- Construction (contractor, developer)
- Residents
- Civic groups
- Special interest groups

Commitment to the process should be achieved at the outset. And even though there may be public representatives on the committee, public meetings for review and comment are essential. Additional possibilities for public information dispersal (so that individual are well enough informed to participate in review and comment sessions) include local newspaper, WWW sites, radio announcements, community postings (in smaller communities), and regular meetings.

The planning team will want to assemble a "planning toolkit" early in the process. This toolkit is composed of information that will form the backbone of the planning effort. It will be an organic entity, evolving throughout the process as new information becomes available. The toolkit may include:

- Current or potential hazard maps
- Existing hazard related documents (reports, inventories, analyses, correspondence)
- Project applications with hazard related information
- Knowledgeable members of the public
- Linkages to databases and other planning projects
- Historical hazards information

In general, the main goals of hazard mitigation are to preserve lives, property, and revenue, and to prevent the disruption of critical services and the economy. These goals should be fine-tuned to reflect community priorities, geographical features, and funding availability. Other parameters for the process will include the range of impacts to be considered (i.e. how much damage is necessary for an event to be considered significant) and the planning horizon (i.e. how far into the future should projections and the strategies consider).

The timeline will reflect the resources that can be brought to bear on the process. An

accurate estimate will be based a jurisdiction's past history and the experiences of others preparing similar plans (contact BDS for referrals). Available funding and resources will also depend on the jurisdiction and community. BDS can supply technical support and literature resources. All but the largest jurisdictions would be well served to contact State agency and university personnel for technical support and to establish a conduit for plan review.

Hazard Identification/Risk Assessment

After initiation, the first step is to determine which of the natural hazards that occur in the state are likely to have a significant impact upon the community. NFPA 1600 states that "the hazard identification and risk assessment determines "what" can occur, "when" (how often) it is likely to occur, and "how bad" the effects could be. For certain of the hazards identified, it will be determined after this preliminary analysis that it is not necessary to carry out a full analysis. These are hazards for which no further action is required."[81]

This document presents sufficient information for the hazard identification phase of this step. The planning team should review Chapter 3 and determine which of the listed natural hazards may have any probability of occurring in the area based on the community's location and basic geography. This phase should generate two lists: an "identified hazard" list of those hazards which are likely to occur in the area and a list of those hazards which are not considered likely in the community. The second list is useful for documenting the finding of "insignificance."

The resultant identified hazard list forms the basis for the risk assessment phase which is a more detailed look at the probability of hazard events occurring locally. Risk assessment will require expert interpretation of the geophysical and climatic features of the area. Mapping of hazards is important to quantifying vulnerability and risk. Risk assessment will utilize existing maps (e.g. FEMA Flood Insurance Rate Maps) and may generate hazard maps where none are available. NFPA 1600 lists a number of approaches to risk assessment, ranging from simple to complex and should be referred to for additional information. The final hazard identification and risk assessment inventory should include for each hazard considered:

- What and Where - Basic description of the hazard as it occurs locally (location, extent and maps, and likelihood).
- Why - Geophysical/climatic characteristics and human factors of the area relevant to the hazard.
- When - Historical occurrences of the hazard (location, extent, damages).
- How Bad - Summary statement of the significance of the hazard (probability, magnitude, spatial extent, population at risk, damage potential).

Local history and knowledge are invaluable in the hazard identification and risk assessment process. Sources include: the media, libraries, emergency response agencies, and local citizens. Base maps and questionnaires can be used by volunteers to record information that can indicate risk areas and past hazard events, such as leaning trees and watermarks on buildings and trees.

[81] National Fire Protection Association. (2000). Standard on Disaster/Emergency Management and Business Continuity Programs (2000 Edition). *NFPA 1600*; A-3-3.1

Impact Analysis

A more detailed study should be performed for each hazard found to be a significant risk in the risk assessment. The impact analysis will be used for identification of specific populations and properties at risk and forms the basis for development of mitigation strategies. Where the risk assessment finds a significant risk of a hazard event occurring, the impact analysis examines what the outcome of such an event would be. This loss estimation is an essential planning tool that helps build an appreciation for the profound impact that natural hazards can have on a community. NFPA 1600 describes it as the "analysis measures the effect of resource loss and escalating losses over time in order to provide the entity with reliable data upon which to base decisions on hazard mitigation and continuity planning."[82]

The impact analysis is a broad description and quantification of potential events that can impact the community.[83] Within the impact analysis, the entity should consider the impact external to its area of influence that can impact the entity's ability to cope with a disaster. [84] For example, an earthquake in an adjacent portion of the state may result in transportation, communication, and utility disruption in the community even though the quake was not felt there.

Most communities will again require outside assistance for completing this step. BDS is applying a comprehensive loss-estimation methodology developed by FEMA that can assist communities in assessing hazards as well as in developing scenarios for mitigation.

NFPA 1600 lists the following as specific community features to be considered by a "life/property analysis":[85]

- Demographics
- Geographical features
- Drainage systems
- Transportation systems
- Life support systems
- Communication systems
- Economic systems
- Key facilities
- Power and pipeline systems
- Land use characteristics
- Key private and public installations
- Agricultural systems
- Production systems
- Emergency management systems
- Tourist concentrations
- Analysis of the weakness or critical points of the subsystems
- Potential growth figures
- Concentrations of population to high-risk areas
- Value of property
- Food supply/distribution
- Canal system
- Energy system
- Susceptibility to hazardous conditions out of the state boundary

In essence, the goal of this step is to identify the "gap" between existing risk controls (emergency management, response and recovery, and hazard mitigation programs and actions) and the magnitude and extent of potential hazard events. Once identified, this informs the community of the needs for further mitigation actions.

[82] Ibid.; 1-3.7
[83] Ibid.; A-3-3.2
[84] Ibid.
[85] Ibid.

Strategy Development

The "planning" of this planning process will occur primarily in this step. Problems (identified hazards) and resources are matched in the context of the process' goals. The general phases of this step are:

- Development of objectives
- Initial strategy development
- Public comment/review
- Revision of strategies

Objectives are concrete restatements of the goals, in tangible terms. They state general approaches to mitigation and may be general (all-hazards) or hazard specific. Objectives establish a framework for approaches to the mitigation task.

Identification of resources is based on both objectives and strategies. Prior identification (based on objectives) helps scope the strategies; post-identification (based on strategies) may make it easier to identify outside resources (e.g. grant programs).

Strategies may range from very definite to less concrete. This will depend on the community's resources, the hazard, and political will. The mitigation strategies may include:[86]

- The use of appropriate building construction standards
- Hazard avoidance through appropriate land-use practices
- Relocation, retrofitting, or removal of structures at risk
- Removal or elimination of the hazard
- Reduction or limitation of the amount or size of the hazard
- Segregation of the hazard from that which s to be protected
- Modification of the basic characteristics of the hazard
- Control of the rate of release of the hazard
- Provision of protective systems or equipment
- Establishment of warning and communication procedures
- Redundancy or duplication of critical systems, equipment, information, operations, or materials

[86] Ibid.; 3-4.3

Implementation

Adoption of the plan will depend on the nature of the "plan" and the jurisdiction undertaking the planning effort. Implementation may take place over a great deal of time and will require a steward of the Plan. Scheduling of the strategies will be based on resources and other demands.

Example implementation tools:

- Inter-jurisdictional planning.
- Open space plan designation for acquisition of hazardous sites.
- Budgeting and capital programs.
- Vegetation management programs.
- Conservation easements.
- Subdivision and zoning codes.
- Grading and drainage measures.
- Building code amendments.

A key element of any implementation strategy will be wide public distribution of the finished product.

The plan should be distributed to all committee participants, to the heads of county departments, to civic leaders, and any individual or organization identified in the planning process as an opinion-maker or as having a stake in mitigation.

A cover letter from the board of county commissioners should explain the reason for the plan and the reason that recipients should be interested in it—public safety, reduced costs of disasters, community cohesiveness.

At the government level, it should inform policy-based decisions on safety issues, buildings, land-use, and planned development. It will have implications for funding loss-reduction projects as well as recovery programs after a damaging event occurs.

For businesses, homeowners, and opinion leaders, the plan provides awareness of hazards and their consequences and a rationale for community-based decision-making, as well demonstrating that individuals need not be helpless victims of natural events.

Monitoring

An essential and often overlooked element of the planning process is monitoring and ongoing revision of the Plan. Monitoring tracks the implementation of the strategies to verify that the objectives and intent of the strategies are being met. Feedback from the monitoring step may be directed at any of the earlier steps with a resulting cascade.

As with the State Plan, ongoing evaluation and revision are necessary to keep the plan functioning over the long-term. Recommendations can be carried out, as funding is available (either through post-disaster assistance or, preferably, through pre-disaster grants or local funds). A plan "champion," either officially charged or unofficially assumed, will go along way towards identifying opportunities for implementation and keeping the plan alive as an active element of the community.

Appendix J
Local Planning Resources

State and Federal Agencies

State

Idaho Department of Administration

The Department of Administration is responsible for actions affecting state buildings.

Idaho Department of Agriculture

The Agriculture Department undertakes resource studies, analysis, and policy recommendations regarding soils and agriculture resource conservation.

Idaho Division of Building Safety

The Division of Building Safety is responsible for implementation of building safety regulations, including code changes for safety and hazard mitigation.

Idaho Department of Commerce

In regard to disaster recovery and hazard mitigation, the State Department of Commerce assists through support and funding for infrastructure and housing.

Idaho Bureau of Disaster Services

The Bureau coordinates mitigation activities for all hazards.

Idaho Division of Environmental Quality

The Environmental Quality Division manages permit processing where required for environmentally sensitive areas, undertakes environmental analyses, and participates in many strategies for hazard mitigation.

Idaho Department of Fish and Game

The Department of Fish and Game undertakes resource studies, environmental analysis, and manages permits applying to fish and game issues.

Idaho Geological Survey

The Geological Survey provides information and resource studies for areas including many hazards including flood, avalanche, landslides, mudslides and volcanic eruption.

Idaho Department of Health and Welfare

This Department assists in analysis of environmental subjects affecting health and welfare issues.

Idaho State Office of Historic Preservation

Under the Office of the State Board of Higher Education, the State historic Preservation Officer assists in providing compliance with the National Historic Preservation Act, the National Environmental Policy Act, and archeological and historical surveys.

Idaho Department of Insurance

This Department deals with fire codes and insurance issues.

Idaho Department of Lands

The Department undertakes resource studies, and manages permit processes relating to State land resources.

Idaho Transportation Department

This Department manages and implements solutions to flood and other hazard mitigation for the State Transportation network, including culvert and other upstream drainage in flood-prone areas.

Idaho Public Utilities Commission

The Commission coordinates State response to utility issues in hazard mitigation, including energy management.

Federal

United States Bureau of Reclamation

The U.S. Bureau of Reclamation administrates projects relating to: irrigation, municipal and industrial water supplies, hydroelectric power, flood control and river regulation, water quality control, outdoor recreation, and fish and wildlife enhancement. These projects may include elements that mitigate flood hazards. The Bureau also administrates Dam Safety programs which provide for inundation studies, inspections, and corrective measures.

United States Federal Emergency Management Agency

The U.S. Federal Emergency Management Agency (FEMA) administrates several disaster assistance programs. Though response activities dependant upon a Presidential Disaster Declaration make up a large share of FEMA's responsibilities, the agency is also active in hazard mitigation. The following are FEMA activities directly related to mitigation of flood hazards:

- Assisting state and local governments in developing flood preparedness and Response capabilities.
- Providing grants for restoration of flood damaged facilities and for hazard mitigation projects.
- Administering the National Flood Insurance Program that provides insurance at reasonable rates to protect buildings and their contents.
- Providing technical assistance and advisory services to communities in developing and administering floodplain management programs.
- Contracting to map floodplains and update floodplain maps.
- Funding or conducting flood hazard studies that provide technical information to define floodways, determine base flood elevations, adopt floodplain management measures, and establish flood insurance premium rates.
- Providing funds for purchase of flood damaged property.

United States Army Corps of Engineers

The U.S. Army Corps of Engineers administers a number of programs designed to control flooding. These programs involve a number of activities including:

- Researching potential flood hazards.
- Assisting states and local governments with flood emergency operations.
- Rehabilitating flood control or shore protection works damaged by flood or coastal storm.
- Completing advance measures before predicted flooding to protect against immediate loss of life and damage.

- Participating on the Federal Interagency Hazard Mitigation Team to provide recommendations for post flood mitigation.
- Providing drainage basin planning assistance to states.
- Providing funds for construction, repair, restoration, and modification of emergency streambank and shoreline protection works to prevent damage to public facilities and nonprofit public services.
- Requiring permits for work in or affecting navigable streams.
- Providing technical and engineering assistance in developing structural and nonstructural methods of preventing damages from shore and streambank erosion.
- Providing funding for small flood control projects.
- Providing technical assistance in evaluating and using flood data to make decisions regarding flood hazards.
- Providing general technical services and guidance on flood damage reduction.
- Providing funding and technical assistance for snag and debris clearance from channels.

United States Geological Survey

The U.S. Geological Survey of the U.S. Department of the Interior conducts flood hazard research including:

- Monitoring and measuring precipitation and floods;
- Installing and maintaining stream gauge systems;
- Developing scientific and technical information on potential hazards.

United States Department of Housing and Urban Development

The U.S. Department of Housing and Urban Development may favor applications that incorporate hazard reduction benefits in the application process for the Community Development Block Grant Program.

United States Small Business Administration

The U.S. Small Business Administration provides post-disaster loans to individuals, families, and businesses for involuntary relocation and for flood damage reduction.

U.S. Natural Resource Conservation Service

The Natural Resource Conservation Service, an agency of the U.S. Department of Agriculture, provides financial and technical assistance for watershed protection and flood prevention. Specific activities related to flood mitigation include:

- Providing financial and technical assistance in emergency situations to safeguard lives and property or mitigate hazards created by natural disasters that suddenly impair a watershed.
- Providing financial and technical assistance to protect, develop, and utilize the land and water resources in small watersheds.
- Providing assistance to communities for river basin surveys.
- Providing snow depth survey and water supply forecasting to assist jurisdictions in management of water resources, and stream flows.

United States National Weather Service

The U.S. National Weather Service, an agency of the National Oceanic and Atmospheric Administration, forecasts weather changes and warns of high water levels in the state's rivers. This agency also provides technical assistance to communities establishing flood warning systems

Appendix K
County-Level Hazard Assessment

County	Major Hazards							
	Flood		UWI Fire		Earthquake		Landslide	
Ada								
Adams								
Bannock								
Bear Lake								
Benewah								
Bingham								
Blaine								
Boise								
Bonner								
Bonneville								
Boundary								
Butte								
Camas								
Canyon								
Caribou								
Cassia								
Clark								
Clearwater								
Custer								
Elmore								
Franklin								
Fremont								
Gem								
Gooding								
Idaho								
Jefferson								
Jerome								
Kootenai								
Latah								
Lemhi								
Lewis								
Lincoln								
Madison								
Minidoka								
Nez Perce								
Oneida								
Owyhee								
Payette								
Power								
Shoshone								
Teton								
Twin Falls								
Valley								
Washington								

County	Other Hazards											
	Avalanche		**Drought**		**Lightning**		**Storm**		**Volcano**		**Wind**	
Ada												
Adams												
Bannock												
Bear Lake												
Benewah												
Bingham												
Blaine												
Boise												
Bonner												
Bonneville												
Boundary												
Butte												
Camas												
Canyon												
Caribou												
Cassia												
Clark												
Clearwater												
Custer												
Elmore												
Franklin												
Fremont												
Gem												
Gooding												
Idaho												
Jefferson												
Jerome												
Kootenai												
Latah												
Lemhi												
Lewis												
Lincoln												
Madison												
Minidoka												
Nez Perce												
Oneida												
Owyhee												
Payette												
Power												
Shoshone												
Teton												
Twin Falls												
Valley												
Washington												

Appendix L
Modified Mercalli Intensity Scale

Modified Mercalli Scale of Intensity	
I	Not felt except by a very few under especially favorable circumstances.
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably indoors especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like a passing truck. Duration estimated.
IV	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Appendix M
Idaho Earthquake History[87]

1. Nov. 10, 1884. Paris, Franklin County, Idaho

The earthquake damaged houses considerably in Paris, about 100 km southeast of Pocatello, near the Idaho-Utah-Wyoming border. It knocked down chimneys and shook stock from shelves in Richmond, Utah, about 125 km north of Salt Lake City. In an area north of Ogden, Utah, the tremor shook a Utah and Great Northern Railroad train. Also reported felt at Salt Lake City, Utah, and Franklin, Idaho.

2. Nov. 11, 1905. Near Shoshone, Lincoln County, Idaho.

Cracks formed in the walls of the courthouse and schools in Shoshone, and plaster fell from ceilings in almost all the buildings. Felt from Salt Lake City, Utah to Baker, Oregon.

3. Oct. 14, 1913. North-central Idaho

A tremor broke windows and dishes in the area of Idaho and Adams counties.

4. May 13, 1916. Boise, Idaho.

The earthquake wrecked several brick chimneys at Boise and sent residents rushing into the street. The shock was described as "violent" at Emmett, 40 km north of Boise, and at Weiser, 96 km west of Boise. Reclamation ditches in the area were damaged. Pressure in a new gas well increased noticeably immediately after the shock. Also felt in western Montana and eastern Oregon.

5. Nov. 25, 1924. Near Wardboro, Franklin County, Idaho.

A slight earthquake in Franklin County on this date broke windows at Wardboro, cracked ceilings at Montpelier, and displaced furniture at Geneva and Montpelier.

6. Near Sheep Mountain, southwest Idaho.

This earthquake apparently was most severe in the area of Fontez Creek, near Sheep Mountain, Idaho, where buildings were shaken so severely that occupants thought the structures were falling apart. A new cabin set on concrete piers was displaced on its foundation. Along Seafoam Creek, rocks and boulders were thrown down the hillside.

Cracks about 30.5 m long formed in the ground in the Duffield Canyon trail along Fontez Creek. Cracks 2.5 to 7.5 cm wide extended for several meters in a continuous break near Seafoam. A section of the Rapid River Canyon wall (near Lime Creek) fell into the river. Also felt in Montana, Oregon, and Washington. Seventeen shocks were reported felt, the first of which was the strongest.

7. Feb. 14, 1945. Idaho City, Boise County, Idaho

This tremor broke dishes at Idaho City and cracked plaster at Weiser, northwest of Boise in Washington County. Also felt in Montana, Oregon, and Washington.

[87] Idaho Geological Survey-North Idaho Seismic Network. (n.d.). Historical Earthquakes in Idaho: 1880-1989. Retrieved April 25, 2001, from NISN Web site: http://www.uidaho.edu/igs/nisn/ nisnhist.html.

8. Sept. 25, 1947. Boise, Ada County, Idaho.

Several large cracks formed in a well-constructed brick building at Boise, but damage generally was slight.

9. Dec. 19, 1957. Northern Idaho.

Timbers fell and mine walls collapsed at the Galena Silver mine near Wallace, Shoshone County.

10. Aug. 7, 1960. Near Soda Springs, Caribou County, Idaho.

Southeast of Pocatello and about 14 km east of Soda Springs, cracks formed in plaster and a concrete foundation at a ranch.

11. Jan. 27, 1963. Clayton, Custer County, Idaho.

Plaster and windows cracked at Clayton, northeast of Boise. Large boulders rolled down a hill at Livingston Camp, about 22 km south of Clayton. Several aftershocks were felt in the area.

12. Sep. 11, 1963. Central Idaho.

Plaster fell in buildings at Redfish Lake, south of Stanley in Custer County; a window pane was broken at a fire station in Challis National Forest.

13. April 26, 1969. Ketchum, Blaine County, Idaho.

Cracks formed in concrete floors of structures in Warm Springs and Ketchum. Plaster was cracked at Livingston Mill, 20 km south of Clayton.

14. Mar. 28, 1975. Eastern Idaho.

In the Ridgedale area of the sparsely populated Pocatello Valley, this earthquake shifted several ranch houses on their foundations and toppled many chimneys. At Malad City, 20 km northeast of the epicenter, about 40 percent of the chimneys on old buildings were damaged. Total property damage was estimated at $1 million.

Geologists observed one zone of ground fractures - about 0.6 km long and 5 cm wide - in the south-central section of the valley.

15. Nov. 27, 1977. Cascade, Valley County, Idaho.

Property damage was reported only at Cascade, a few kilometers east of the epicenter, near Cascade Dam. The tremor cracked foundations and sheetrock walls, separated ceiling beams, and left muddy water in wells and springs. Also felt in Oregon.

16. Oct. 24, 1978. Southeast Idaho.

Cracks formed in plaster and a concrete foundation at Thatcher in Franklin County. This earthquake was felt in Bannock and Franklin Counties of southeast Idaho, and at Plymouth , Utah, south of Pocatello, Idaho.

17. Oct. 14, 1982. Near Soda Springs, Caribou County, Idaho.

In the Soda Springs area, about 45 km southeast of Pocatello, bricks fell from chimneys and cracks formed in the foundation of a house and interior drywalls. Also felt in Utah and Wyoming.

18. Oct. 28, 1983. Borah Peak, Custer County, Idaho.

The Borah Peak earthquake is the largest ever recorded in Idaho - both in terms of magnitude and in amount of property damage. It caused two deaths in Challis, about 200 km northeast of Boise, and as estimated $12.5 million in damage in the Challis-Mackay area. A maximum MM intensity IX was assigned to this earthquake on the basis of surface faulting. Vibrational damage to

structures was assigned intensities in the VI to VII range.

Spectacular surface faulting was associated with this earthquake - a 34 km long northwest trending zone of fresh scarps and ground breakage on the southwest slope of the Lost River Range. The most extensive breakage occurred along the 8 km zone between West Spring and Cedar Creek. Here, the ground surface was shattered into randomly tilted blocks several meters in width. The ground breakage was as wide as 100 km and commonly had four to eight en echelon scarps as high as 1-2 m. The throw on the faulting ranged from <50 cm on the southern-most section to 2.7 m south of rock creek at the western base of Borah Peak.

Other geologic effects included rockfalls and landslides on the steep slopes of the Lost River Range, water fountains and sand boils near the geologic features of Chilly Buttes and the Mackay Reservoir, an increase or decrease in flow of water in springs, and fluctuations in water levels. A temporary lake was formed by the rising water table south of Dickey.

The most severe property damage occurred in the towns of Challis and Mackay, where 11 commercial buildings and 39 private houses sustained major damage and 200 houses sustained minor to moderate damage.

At Mackay, about 80 km southeast of Challis, most of the commercial structures on Main Street were damaged to some extent; building inspectors condemned eight of them. Damaged buildings were mainly of masonry construction, including brick, concrete block, or stone. Visible damage consisted of severe cracking or partial collapse of exterior walls, cracking of interior walls, and separation of ceilings and walls at connecting corners. About 90 percent of the residential chimneys were cracked, twisted, or collapsed.

At Challis, less damage to buildings and chimneys was sustained, but two structures were damaged extensively: the Challis High School and a vacant concrete-block building (100 years old) on Main Street. Many aftershocks occurred through 1983. Also felt in parts of Montana, Nevada, Oregon, Utah, Washington, Wyoming, and in the Provinces of Alberta, British Columbia, and Saskatchewan, Canada.

Appendix N
Volcanic History of the Pacific Northwest[88]

Washington

Mount Baker erupted in the mid-1800's for the first time in several thousand years. Activity at steam vents (fumaroles) in Sherman Crater, near the volcano's summit, increased in 1975 and is still vigorous, but there is no evidence that an eruption is imminent.

Glacier Peak has erupted at least six times in the past 4,000 years. An especially powerful series of eruptions about 13,000 years ago deposited volcanic ash at least as far away as Wyoming.

Mount Rainier has produced at least four eruptions and numerous lahars in the past 4,000 years.

Mount St. Helens is the most frequently active volcano in the Cascades. During the past 4,000 years, it has produced many lahars and a wide variety of eruptive activity, from relatively quiet outflows of lava to explosive eruptions much larger than that of 1980.

Mount Adams has produced few eruptions during the past several thousand years. This volcano's most recent activity was a series of small eruptions about 1,000 years ago.

Oregon

Mount Hood last erupted about 200 years ago, producing small pyroclastic flows, lahars, and a prominent lava dome (Crater Rock) near the volcano's summit. Most recently, a series of steam blasts occurred between 1856 and 1865.

Mount Jefferson last erupted more than 20,000 years ago. However, eruptions nearby have produced several lava flows and small volcanic cones in the past 10,000 years.

Three Sisters Volcanic Center in central Oregon includes five large volcanoes, North Sister, Middle Sister, South Sister, Broken Top, and Mount Bachelor. South Sister is the youngest volcano in the group; its most recent eruption was about 2,000 years ago. Middle Sister and Mount Bachelor have not erupted in the past 8,000 years, and North Sister and Broken Top have probably been inactive for 100,000 years.

Newberry Volcano, a broad shield covering more than 500 square miles, is capped by Newberry Crater, a large volcanic depression (caldera) 5 miles across. Its most recent eruption was about 1,300 years ago.

Crater Lake occupies a 6-mile-wide caldera formed 7,700 years ago when the summit of an ancient volcano (referred to as Mount Mazama) collapsed during a huge explosive eruption. More than 10 cubic miles of magma was erupted, ten times as much as in any other eruption in the Cascades during the past 10,000 years. Smaller eruptions about 5,000 years ago formed Wizard Island and a lava dome on the lake floor.

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[88] *Excerpted from:* Dzurisin, D., Stauffer, P. H., & Hendley, J. W. II. (1997). Living With Volcanic Risk in the Cascades. *U.S. Geological Survey Fact Sheet 165-97 Online Version 1.0.* Retrieved May 26, 2001, from U.S. Geological Survey Web site: http://geopubs.wr.usgs.gov/fact-sheet/fs165-97/.

Northern California

Medicine Lake Volcano, a broad shield capped by a 4- by 7-mile caldera, has erupted at least 8 times in the past 4,000 years, most recently about 900 years ago. With a volume of more than 130 cubic miles, it is the largest volcano in the Cascades.

Mount Shasta has been the most active volcano in California during the past 4,000 years, second in the entire Cascade Range to Mount St. Helens. During that time, Shasta has erupted on average about once every 300 years, producing many pyroclastic flows. It probably last erupted in 1786.

Lassen Volcanic Field, including Lassen Peak, is the southernmost volcanic center in the Cascades. The most recent volcanic eruptions in California occurred at Lassen Peak from 1914 to 1917. An explosive eruption on May 22, 1915, produced a large pyroclastic flow, lahars, and ash that fell as far away as Elko, Nevada, 300 miles to the east.

Figure 1 illustrates the approximate location of the Cascade volcanoes and an overview of their recent eruptive history.

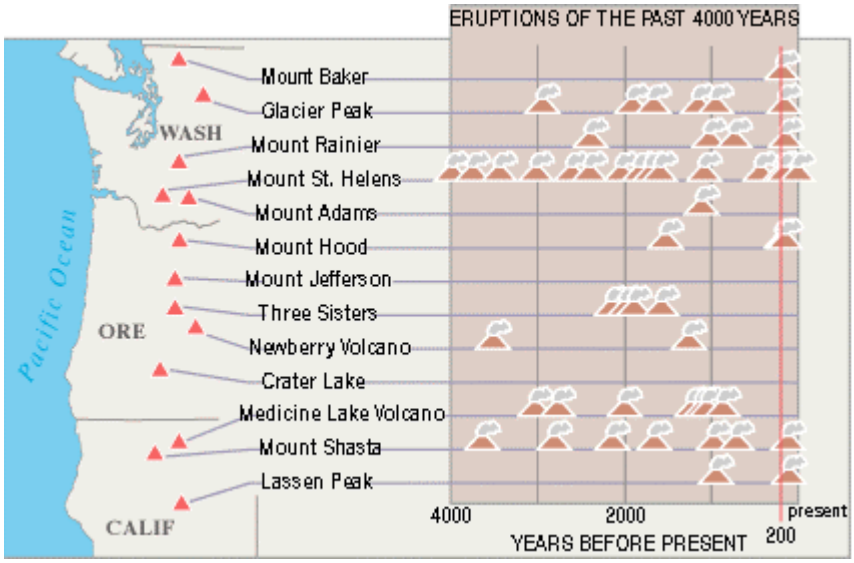

Figure 1 - Cascade Volcanoes

Appendix O
Proposed Prioritization Criteria

Evaluate each project using the criteria on the score sheet. Each project is rated on how well it meets or exceeds each listed objective by assigning a score as follows:

4 = Exceeds	1 = Meets some
3 = Meets all	0 = Meets none
2 = Meets most	N = Not applicable

The numerical scores for each project will be averaged (i.e., not applicable items will not be used). You may NOT use **N** as a response in shaded boxes.

Projects will then be listed from highest average score to lowest. They may be grouped into similar categories with priorities spread over the categories.

Does the project:		SCORE
1	Have significant beneficial impact on the declared disaster area?	
2	Independently solve the problem identified?	
3	If part of a larger project, provide assurance that the larger project will be completed?	
4	Substantially reduce the potential for the damage, hardship, loss, suffering, or death that could result from a future disaster?	
5	Address a repetitive problem?	
6	Address a significant risk if left unresolved?	
7	Protect lives?	
8	Reduce public risk?	
9	Provide a long-term solution?	
10	Meet the priorities for projects established by the state?	
11	Meet the goals of the State Hazard Mitigation Plan?	
12	Reduce vulnerability for existing structures and developed property?	
13	Reduce the number of vulnerable structures?	
14	Address secondary damage issues (such as landslides resulting from floods or wildfire)?	
15	Protect or restore wetlands and floodplains?	

Does the project:		SCORE
16	Restore or protect natural resources, recreational areas, open space, or other environmental values?	
17	Improve the capability of state agencies and county or local governments to exchange time-sensitive information during the disaster?	
18	Improve the capability or effectiveness to report time-sensitive information, relay information, or warn the public?	
19	Increase public awareness of the hazard, of preventive measures, and of emergency response?	
20	Demonstrate development and implementation of comprehensive programs, standards, and regulations that reduce future damage?	
21	Propose and evaluate alternative solutions?	
22	Provide a reasonable solution in terms of cost, use of technology, or scope of work?	
23	Show reasonable operation and maintenance costs which the local jurisdiction is committed to support?	
24	Show local commitment to mitigation?	
25	Show local commitment to funding?	
26	Present material clearly and coherently?	
COMMENTS		

REVIEWER	
AGENCY	DATE